INTEGRATED EDITION OF THE PETROLEUM ENGINEER

the Petroleum Engineer

FOR MANAGEMENT

JUNE 1959

CONTENTS: 2 AD INDEX: 6

ONE DOLLAR FIFTY CENTS A COPY

12th Annual Round-Up

WORLD OPERATIONS Attain New Records

How to Treat Hydraulic Fractures

A symposium on concepts, technology and selection.....Page B-43

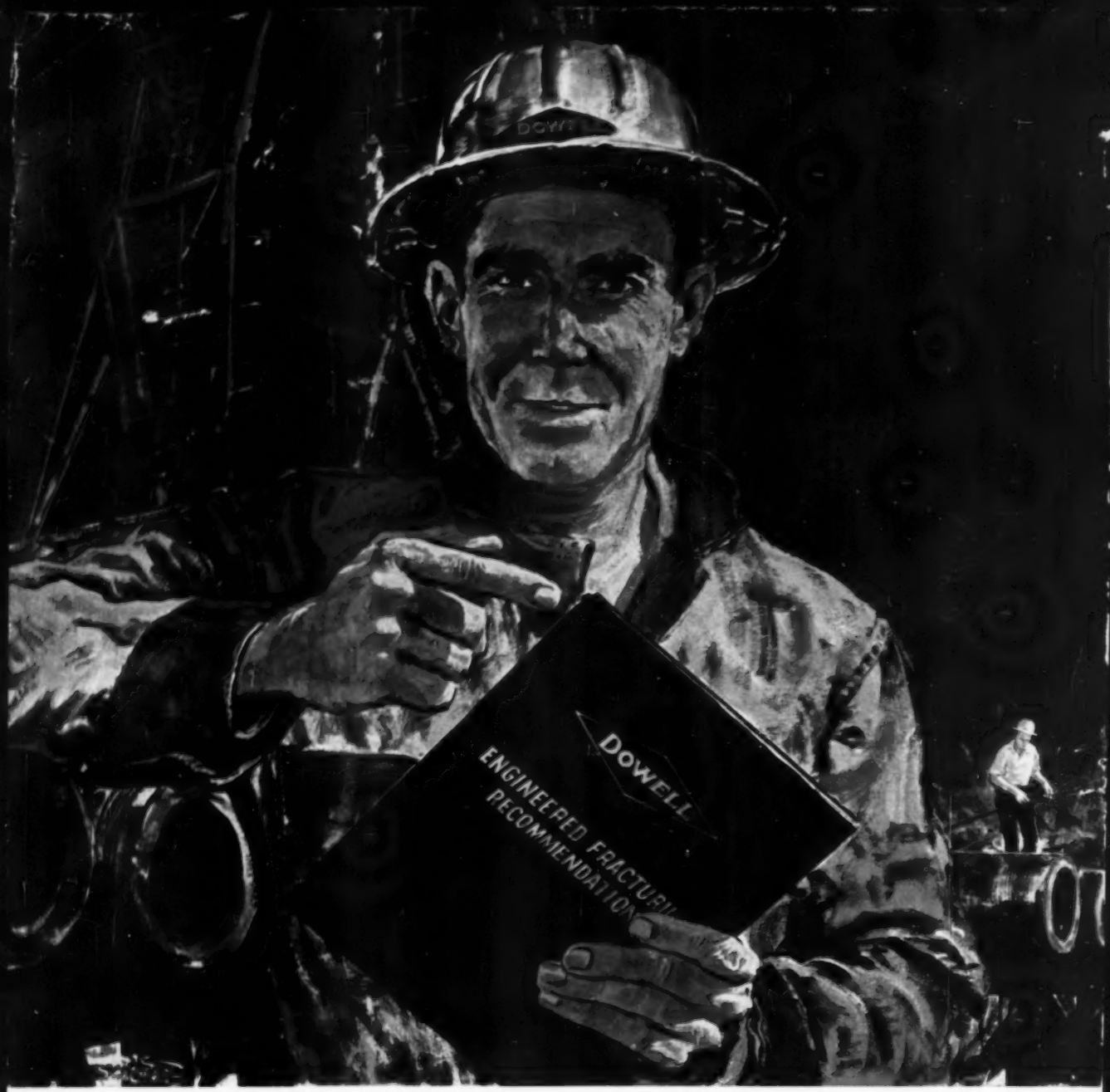
Graphic Method Speeds Line Sizing

Accurate and rapid calculation now possible.....Page C-10

Gas Crosses Last U. S. Frontier

Texas to Florida: Year's Biggest Pipeline Project.....Page D-19

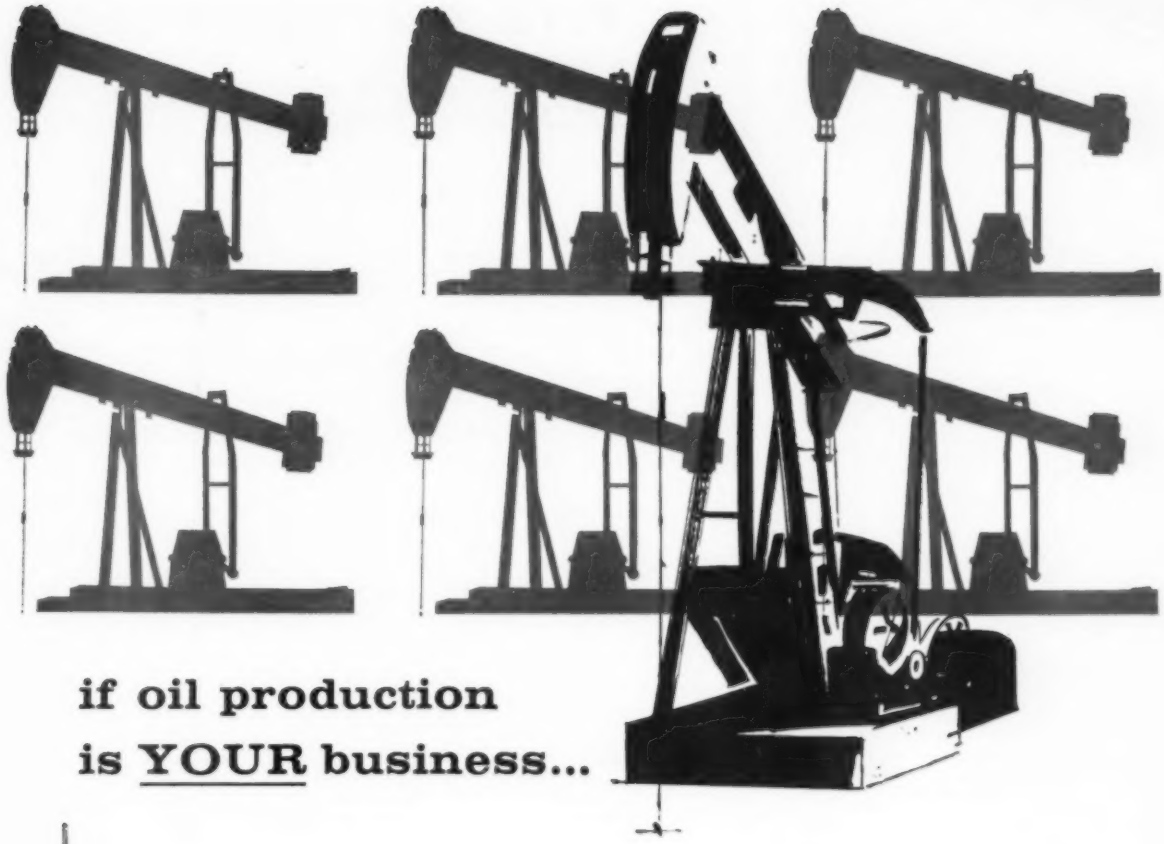
World-Wide Directory of Supply and Service Companies



DOWELL CAN PRESCRIBE the *best* treatment for your well. Here's why: Dowell originated *inhibited acidizing* for oil wells some 27 years ago and has improved the techniques continuously. Dowell developed *fracturing* from its original concept to a scientific stimulation service. Through these efforts you now have a wide choice of acid-base, water-base and oil-base services. The latest Dowell development to help you get better production is the "Frac Guide." Of all service companies in the field today—Dowell has the longest experience in well stimulation, the widest background in oilfield chemistry, the greatest variety of acidizing and fracturing services. The ability to apply the proper service to your problem is one more reason why Dowell gives you the most value per treatment dollar. Dowell, Tulsa 1, Oklahoma.

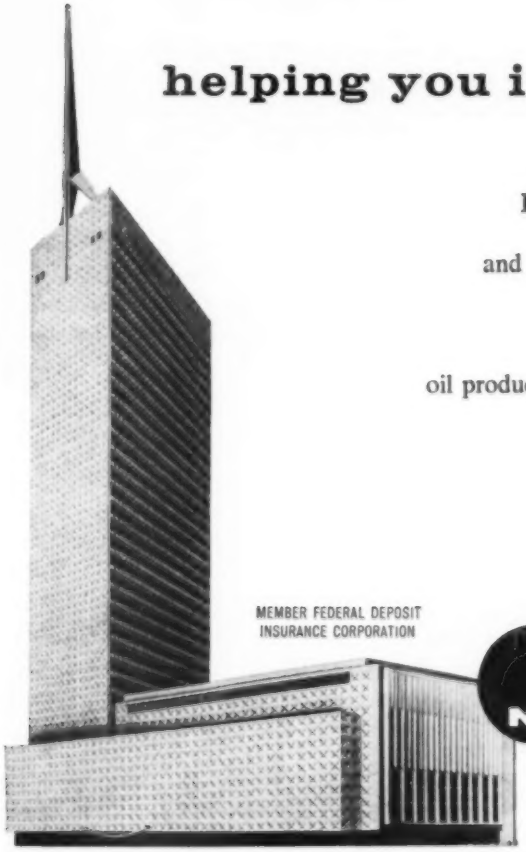
Services for the oil industry DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY



if oil production is YOUR business...

helping you is OUR business



Here, at Republic National Bank, the combined experience and proved performance of the South's largest and most active Oil Department are concentrated on better service to the oil producer. However complex your production financing problem, you'll get expert attention to your requirements at Republic. How may we help you?

ADDED STRENGTH YOU CAN BANK ON

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

REPUBLIC National BANK of Dallas

CAPITAL AND SURPLUS $100,000,000
LARGEST IN THE SOUTH

Joe B. Woods
President and Publisher
Abbott Sparks
Vice President and Advertising Director
E. V. Perkins
Vice President and Western Manager
J. E. Kastrop
Editorial Director
L. H. Johnston
Secretary-Treasurer

•

Ernestine Adams
Management Editor
Jack W. Williamson
Editor, Drilling and Producing
Frank H. Love
Editor, Pipeline Engineer
J. C. Webb Jr.
Editor, Refining Engineer
C. R. Graham
Assistant Editor, Drilling and Producing
Lowell A. Murphy
Field Editor
Jan Craig
Editorial Production Manager
Lynn Patton
Editorial Assistant
Cecile Pincus
Editorial Assistant
Donald D. Fickert
Presentation Editor

•

NEW YORK — **John L. McDonald**
Clyde Dillehay
52 Vanderbilt Ave., MUrray Hill 6-7232
CHICAGO — **E. V. Perkins**
Robert T. Mahoney
53 West Jackson Blvd., HArrison 7-6883
LOS ANGELES — **Richard P. McKey**
465 East Union, Pasadena, RYan 1-0685
PITTSBURGH — **Art G. Gilliam**
121 Ambleside Dr., WEllington 1-0619
HOUSTON — **Jess Adkins**
2370 Rice Blvd., Room 110, JAckson 6-2631
DALLAS — **Ed Sealey**
800 Davis Building, Riverside 8-4403
BIRMINGHAM — **Fred W. Smith**
1201 Forest View Lane, Vesthaven
TRemont 1-5762

•

Allen K. Tyler
Production Manager
Glen D. Hebert
Assistant Production Manager
Paul J. Mansfield
Advertiser Services Manager
Charles McKean
Circulation Director
Royal Courtney
Circulation Fulfillment Manager
Sherwood R. Entwistle
Circulation Promotion Manager

Cable Address: PEPUB

Copyright 1959
The Petroleum Engineer Publishing Company
Indexed by
Applied Science and Technology Index,
The Engineering Index, Inc.,
and Chemical Abstracts
Member of Audit Bureau of Circulation
and Associated Business Publications

The Petroleum Engineer for Management, published monthly, August through June, semi-monthly in July, by The Petroleum Engineer Publishing Company, 800 Davis Building, Dallas 2, Texas. Subscription rate to the petroleum industry, United States, Canada, and foreign, $8.00 per year; $14.00 for 2 years; $18.00 for 3 years; $1.50 for single copy. Entered as second-class mail matter May 1, 1932, at the post office in Dallas, Texas, under the act of March 3, 1879. Please send subscription correspondence and change of address to The Petroleum Engineer Publishing Company, P. O. Box 1589, Dallas 21, Texas. Subscribers should notify publisher promptly of any change of address, giving old as well as new address, and including city postal delivery zone, if any. If possible, enclose an address label from a recent issue of the magazine. Allow one month to six weeks for change to become effective.

THE PETROLEUM Engineer

FOR MANAGEMENT

NUMBER 6 • VOLUME XXXI • JUNE, 1959

The Conference Table **A-10**

"Business without profit is not business any more than a pickle is candy." — *Charles F. Abbott*

Expansion of Knowledge Aim of World Petroleum Congress .. **A-18**

An interview with E. V. Murphree, Chairman of the Congress

World Industry Attains Records — S l o w l y **A-20**

Petroleum production, consumption, refining capacity and runs reach their highest mark in 1958 but increase lags behind recent years . . . USSR has steep rise in consumption and expansion in all operations . . . Another year of world-wide records predicted for 1959 . . . — *Ernestine Adams*

Countries and territories covered in Part 1 are:

ADEN
AFGHANISTAN
ALASKA
ALBANIA
ALGERIA
ANGOLA
ARGENTINA
AUSTRALIA
AUSTRIA
BAHAMAS
BAHRAIN
BARBADOS
BELGIAN CONGO
BELGIUM
BOLIVIA
BORNEO (Br.)
BORNEO (Indonesia)
BRAZIL
BRITISH GUIANA
BULGARIA
BURMA
CAMEROONS (French)
CANADA
CEYLON
CHILE
CHINA (Communist)
COLOMBIA
COSTA RICA
CUBA
CYPRUS
CZECHOSLOVAKIA
DENMARK
DOMINICAN REPUBLIC
ECUADOR
EGYPT
FINLAND
FORMOSA
FRANCE
FRENCH EQUATORIAL AFRICA (Gabon)
FRENCH WEST AFRICA
GAMBIA (Br.)
GERMANY (East)
GERMANY (West)
GHANA
GREECE
GUATEMALA
HAITI
HAWAIIAN ISLANDS
HONDURAS
HONDURAS (Br.)
HUNGARY
INDIA
INDONESIA
IRAN
IRAQ
IRELAND
ISRAEL
ITALY
JAMAICA
JAPAN
JAVA (Indonesia)
JORDAN
KENYA
KOREA
KUWAIT
KUWAIT-SAUDI ARABIA NEUTRAL ZONE
LEBANON
LIBYA
MADAGASCAR
MALTA
MEXICO
MOROCCO

Other countries will be covered in Part 2, to be published in the July issue.

Research at Sunbury **A-37**

British Petroleum, founded 50 years ago, has one of the industry's top research organizations. This is how the big Center is set up. — *V. S. Swaminathan*

E SECTION FOLLOWS A

Think About Those Below You Too **E-1**

Another chapter in the popular "How to be a Manager" series. — *Gerald F. Bassler*

The Danger of Political Inactivity **E-8**

Book by General Electric's Political Affairs Manager provides reliable guide to politics for business and industry.

World-Wide Directory ..... **Insert**

List of Petroleum Industry Supply and Service Companies represented in countries where there are oil operations.

DRILLING AND PRODUCING

WORLD-WIDE OPERATIONS

Trinidad: Floating Barge Drills, Tests, Completes Deep Well B-19
Egypt: Petroleum Progress and Problems B-20
Israel: Heletz Field B-23
Papua: Petroleum Find B-24
Guatemala: The Big Rig Fly-In B-26
Cuba: Civil Strife Calms, Drilling Resumes B-30
Testing Lab for Logging Cable Improves Depth Measurements B-29
Helicopter Shuttle Service B-32
The Atlantic Lectures of The University of Texas, Part 8 . . . . . B-34

FRACTURING SYMPOSIUM

Increased Fracturing Efficiency by Fluid Loss Control B-43
Engineering Safety into Well Stimulation Work B-46
Are You Considering All the Factors in Designing a Fracturing Treatment? B-50
Choosing a Fracturing Fluid B-56
Fracture Propping Agents B-65
Perforation Ball Sealer Technology B-82
Gas Condensate Reservoirs, Part 3 . . . . . B-108
Drilling and Production Papers . . . Fifth World Petroleum Congress . . B-110
Legal Systems Governing Oil Exploration and Development in Foreign Countries B-117
Further Discussion of Effects of Curtailment on Waterflood Recovery . . . B-128

REFINING AND PETROCHEMICAL

Fifth World Petroleum Congress — Refining Papers, Schedule C-3
Graphic Method Speeds Line Sizing C-10

SELECTED API REFINING PAPERS

Corrosion: Aluminizing Resists Refinery Sulfidation and Oxidation . . C-20
Instrumentation: New Installation Guide C-28
Processing: Processing Crude Oil at Low pH C-29
Guiding Refining Operations with Small Semi-Automatic Pilot Plants C-35
Distillation in View of Modern Developments, Part 2 . . . . . C-46
Russian Refining Emphasis Is on Growth C-64
Refinery Construction Manual, Part 10 . . . . . C-74

OIL AND GAS PIPELINING

Gas Crosses Last U. S. Frontier D-19
Hydraulic Testing Becomes Complex at High Altitudes D-28
Russia Revises Pipeline Goals D-34
Trans-Canada Has Its Operating Problems D-43
Abstracts of World Petroleum Congress Papers D-46
Sui-Multan Pipeline Is Asia's Second Long Transmission System D-48
Pipeline Through Bush and Swamp D-51
Fifty Years of Progress in Pipeline Operations, Part 2 . . . . . D-52
Pipeline Fundamentals: Design for a Practical Safety Program, Part 2 . . D-60
Pipeline Handbook Data Sheets D-67
Can Small-Diameter Pipelines Compete with the Large-Diameter? . . . D-69
Fire Protection for Unattended Pump Stations D-72

FEATURES

The Course of Oil A-4
Advertisers' Index A-6
Petroleum Profile A-8
G. M. Knebel
Highlights of Industry News A-12
Meetings A-14
Laugh with Barney E-11
Management Personals E-14
The Trade Parade E-20
Of Things To Come in Oil B-3
Running Tour with Men in the Industry . B-137
Exploration Activities B-140
What's Doing in Drilling B-144
New Drilling and Producing Equipment . B-147
New Drilling and Producing Literature . . B-151
Refining Personals C-79
New Refining Equipment C-82
New Refining Literature C-84
Pipeline Projects D-75
With the Pipeline Contractors D-77
Pipeline Personals D-79
New Pipeline Equipment D-80
New Pipeline Literature D-82

Four Editions
Published Monthly by
The Petroleum Engineer
Publishing Company
800 Davis Building
Dallas 2, Texas

THE PETROLEUM Engineer
FOR MANAGEMENT
INTEGRATED EDITION OF THE PETROLEUM ENGINEER

THE PETROLEUM Engineer
DRILLING AND PRODUCING
SPECIALIZED EDITION OF THE PETROLEUM ENGINEER

REFINING Engineer
SPECIALIZED EDITION OF THE PETROLEUM ENGINEER

PIPELINE Engineer
SPECIALIZED EDITION OF THE PETROLEUM ENGINEER

REGULATIONS REVOLUTION

IN THIS MONTH when we welcome members of the petroleum industry from countries all over the globe, we would like to tell them and remind ourselves of a revolution our ancestors fought here.

It was essentially a revolt against mercantilism detailed by bureaucratic directives from England. The Colonists were treated well politically for those days but regulations of all business and trade pushed irritation into rebellion.

Every big movement has its prophet. Adam Smith's "Wealth of Nations" was the inspiration of the American Revolution. He believed the key to economics was people and that in individuals rested the wealth of nations. A reformer, he sought to lift from the backs of businessmen and farmers and labor the heavy hand of bureaucratic rule. He believed an individual could provide more for himself and for his state than the state could ever provide for its nationalists.

It turned out he was right.

Today mercantilism and autocratic rule are forcing their way back. In our country a man is fined for growing feed on his own land for his own livestock because Washington has not given permission. A prospector who finds gas is a public utility if he sells the production across a state line. The Government even sets the price.

The old aristocracy vanished but we have new autocrats. We have labor union organizations where membership depends on whether you are born into it. And your job in many industries can depend on your submission to a union boss.

If the "Free World" is chained again by mercantilism we'll all go back to the Middle Ages — or be taken in by the Communists, who have a modern version of the old economic theory of mercantilism.

How many pages does your Oil Code take, Friends from Abroad? No matter, ours probably takes more. Paper work for governments in the petroleum industry accounts for a substantial part of our costs. Is it freedom when you have to come out of an economic jail to vote?

Our U. S. industry was well established before multiple laws and decrees hemmed it in. If it had begun with the regulations that are on its back now, we'd still be hunting whales for oil.

If your country needs energy — as most of us do —make it easy on yourselves and the oil company brave enough to provide it. Historically there has never been a successful nationalized petroleum industry, but look how we persist in trying! Smith said private economic effort beat government enterprise and we proved it. It's as inexorable as a mathematics formula.

But mercantilism, which gives power to little men, keeps expanding. Tight cages of laws and regulations squeeze the enterprise of the petroleum industry. Can't we have a regulation revolution in our own industry — in your country and in ours? Let's deal in confidence instead of fear. It's a great petroleum producer.

Ernestine Adams.

Congrats and $25 for this quip to J. B. VANDERGRIFT, Vandergrift Oil & Gas, Independent Producer, Pittsburgh, Pa.

You can "put this in your pipe and smoke it" . . . Lone Star casing, tubing and line pipe is the most popular in the industry . . . because it is tough, dependable and available conveniently right in the middle of the oil country.

Made by the oil man's own steel mill, Lone Star API pipe is the specialty of the house . . . where quality control is rigidly maintained for Joe Roughneck's personal satisfaction.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.

Lone Star STEEL COMPANY

©1956 Lone Star Steel Company

EXECUTIVE—SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas
DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

ADVERTISERS' INDEX

— A —

ACF Industries, Incorporated — W-K-M Division B-123, C-54, A-41
Aero Service Corporation B-94
Ajax Iron Works B-16
Allen-Bradley Co. E-19
Allied Chemical Corp., Solvay Process Division C-82
American Brass Company, The, Buffalo Division C-53
American Iron & Machine Works Co. ... B-95
American Meter Company E-11, E-26
American Recording Chart Company E-28
American Steel & Wire Division of United States Steel E-6, E-7
Armite Laboratories C-84
Axelson Manufacturing Company, Division of U. S. Industries, Inc. .. B-10, B-11

— B —

B & W, Inc. B-149
Babcock & Wilcox Co., The Refractories Division C-21
Tubular Products Division, Fittings Department C-49
Baker Oil Tools, Inc. B-18, B-38, B-39
Barber-Greene D-18
Baroid Division, National Lead Co. B-125, B-126
J. B. Beaird Company A-17
Bell Helicopter Corporation D-16
Bethlehem Steel Company D-12, D-13
Black, Sivalls & Bryson, Inc. A-16
Blaw-Knox Company, Buflovak Division .. D-61
Born Engineering Company C-17
Brakesol, Inc. E-32
Burgess-Manning Company E-20
Burndy D-59
Byron-Jackson Tools, Inc., A Subsidiary of Borg-Warner Corporation B-120

— C —

Cable & Stephens B-151
Cabot Shops, Inc. B-1
Cameron Iron Works, Inc. B-149
Carrier Corporation C-62, C-63
Catawissa Valve & Fitting Company E-14
Caterpillar Tractor Company E-5
Chicago Bridge & Iron Company A-35
Christensen-Diamond Products B-64
Classified Advertising E-30
Clayton Mark & Co. E-27
Cleveland Trencher Co., The D-45
Coates Field Service, Inc. D-82
Colorado Fuel and Iron Corp., The B-4
Continental-Emsco Company, a Division of The Youngstown Sheet and Tube Company B-59, B-60, B-61, B-62, B-122
Continental Oil Company B-90
Cooper-Bessemer Corporation E-12, E-13
Cosasco Division, Perfect Circle Corp. C-47
M. J. Crose Manufacturing Company, Inc. A-40
Crossett Company, The, Chemical Div. .. B-139
Crutcher-Rolfs-Cummings D-1

— D —

Darling Valve & Manufacturing Co. D-57
Davison Chemical Company, Division of W. R. Grace & Co. C-71
Dayton Rubber Company B-58
Dempster Brothers, Inc. A-15
Diamond Chain Company, Inc. .. B-130, B-131
Dowell ..... Inside Front Cover, A-13
Drilling & Service, Inc. B-5
Drilling Specialties Company B-129
Du Pont, E. I., de Nemours & Co., Inc. C-39, C-40, C-76
Durametallic Corporation C-84
Duriron Company, Inc., The A-36

— E —

Edwards Valves, Inc. B-138
Ethyl Corporation C-4, C-5

— F —

Fleetline Co. D-81
Floridin Company E-15
Foxboro Company, The D-3
Franks Division of Cabot Shops, Inc. B-1

— G —

Gardner-Denver Company B-66, B-67
Garrett Corporation, The, AiResearch Industrial Division D-55
Garrett Oil Tools, Division of U. S. Industries, Inc. B-141
Gaso Pump & Burner Mfg. Co. D-10
Gates Rubber Co., The B-116
General American Transportation Corp., Plate & Welding Division E-25
General Electric Co. B-69
Geolograph Oil Field Service Co. B-146
GPE Controls, Inc. E-16
Graver Tank & Mfg. Co., Inc. C-65
Grove Valve & Regulator Company E-31
Guiberson Corporation, The B-97
Gulf Coast Machine & Supply Co. B-101
Gulf Oil Corporation A-9

— H —

Halliburton Oil Well Cementing Company B-2, B-77, B-112
Hallmac Construction Company D-78
Harbison-Fischer Mfg. Co. B-106
Hercules Tool Company B-142
H & M Pipe Beveling Machine Co. D-79
Houdry Process Corporation C-66, C-67
Hotel Times Square E-30
Houston Oil Field Material Co., Inc. B-100
Hughes Tool Company ..... Back Cover
Humble Oil & Refining Co. C-60
Hunt Tool Co. B-118
Hycalog, Inc. B-137, B-145
Hydril Company B-45

— I —

Ingersoll-Rand C-72, C-73, E-32
Insley Manufacturing Corporation D-4
International Nickel Company, Inc., The C-57

— J —

Jensen Bros. Mfg. Co. B-137
Johns-Manville Products D-40, D-41
Johnston Testers, Inc. B-6, B-7
Jones & Laughlin Steel Corporation, B-92, B-93

— K —

The M. W. Kellogg Company, A Subsidiary of Pullman Incorporated C-69
Kellogg Switchboard & Supply Co. D-11
Kerrigan Iron Works, Inc. C-81
Koch Engineering Company, Inc. C-31

— L —

Lane-Wells Company ..... Inside Back Cover
Lebus International Engineers, Inc. B-113
Lenape Hydraulic Pressing & Forging Co. C-79
Liberty Manufacturing Co. of Texas B-17
Lone Star Steel Company A-5
Lucey Export Co. B-132
Lufkin Foundry & Machine Company B-87
Lufkin Rule Company, The E-26

— M —

Mack Trucks, Inc. B-134
Magnet Cove Barium Corporation B-8, B-9
F. H. Maloney Company D-17
Marsh Instrument Co. E-10
John N. Martin, Manufacturer B-91
Martin-Decker Corporation B-83
C. A. Mathey Machine Works, Inc. B-146
Mercantile National Bank E-32
Merla Tool Corporation B-140
Mid-Continent Supply Co. B-12
Miller Sand Pump Co. B-151
Milwhite Mud Sales Company B-151
Minneapolis-Honeywell D-36, D-37
Mission Manufacturing Co. B-53
Motorola Communications & Electronics, Inc. D-47

— Mc —

McCullough Tool Company B-119

— N —

National Supply Company, The B-71, B-72, B-73, B-74
National Tank Company E-34
National Tube Division of United States Steel B-79
Nicolet Industries, Inc. D-53
Nordberg Mfg. Co. D-5
Nordstrom Valve Division, Rockwell Mfg. Co. A-42, E-21, E-22, E-23, E-24
W. C. Norris, Manufacturer, Division of Dover Corporation B-57
Northern Ordnance Incorporated, Subsidiary, Northern Pump Co. E-26

— O —

Oakite Products, Inc. B-148
Oil Center Tool Co. B-135
Oil States Rubber Co. B-55
Oil Well Supply Division of United States Steel A-7
Orbit Valve Company B-14
Otis Engineering Corporation B-111

— P —

Pacific Pumps, Inc. B-152
Pelican Supply Co., Inc. D-76
Petreco Division, Petrolite Corp. A-39
Petro-Chem Development Co., Inc. E-33
Petroleum Electric Power Association E-9
Petroleum Equipment Suppliers Association B-89
Pipeline Cleaners Co. D-80
Pittsburgh Coke and Chemical Co. B-52
Chas. Pfizer & Co., Inc., Chemical Sales Division B-13
Polyken Products, Division of The Kendall Co. D-8, D-9
Procon, Incorporated C-1

— R —

Rector Well Equipment Company, The ... B-85
Reda Pump Company B-150
Reed Roller Bit Company B-114, B-115
Reinhold Publishing Corporation .. C-58, C-59
Republic National Bank of Dallas A-1
Rockford Clutch Division, Borg-Warner . B-143
Rust-Oleum Corporation E-29

— S —

Schlumberger Well Surveying Corp. B-103
Security Engineering Division B-105
Shaffer Tool Works B-81
Sheehan Pipe Line Construction Co. D-74
M. B. Skinner Co. C-70, D-80
A. O. Smith Corporation D-6, D-7
Solar Chicago, Division of U. S. Industries E-17
Standard Oil Company (N. J.) E-18
Stearns-Roger Mfg. Co., The C-37
Steel Forgings, Inc. D-81
Stratford Engineering Corporation C-34

— T —

Tapecoat Company, The D-15
Taylor, S. G., Chain Company, Inc. . B-150, D-73
Teletype Corporation D-14
Thompson Tool Co. B-147
Thornhill-Craver Company B-75
Tinker & Rasor D-66
Tretolite Division, The Petrolite Corp. ... C-23

— U —

Union Wire Rope Corporation, Subsidiary of Armco Steel Corp. . B-40, B-41
United States Steel Stainless Steel C-45
Universal Oil Products C-43, C-75, D-2

— V —

Valley Electric Company E-30
Henry Vogt Machine Co. C-2

— W —

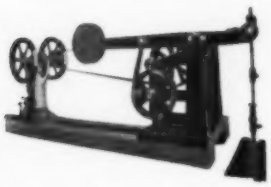
Warner-Lewis Company C-51
Waukesha Motor Company B-15, B-136
Western Geophysical Company B-104
Western Supply Company C-78
Wheeling Machine Products Company ... E-30
Wheland Company, The B-49
Wickes Boiler Co. C-80
Williams Brothers E-32
T. D. Williamson, Inc. D-49
Wilson Supply Company B-99

— Y —

Yarnall-Waring Company C-27

THIS INDEX IS PROVIDED AS AN ADDITIONAL SERVICE FOR OUR READERS—THE PUBLISHER ASSUMES NO RESPONSIBILITY FOR ERRORS OR OMISSIONS

"Oilwell" Pumping Units down through the years



1902 This early beam-type pumping unit had cast-iron frame and single-reduction, open-spur gear train.

1916 Featured unitized structural steel walking beam and base beam. Note double-reduction, open-spur gearing.

1928 This foreshadowed modern units with its counterbalanced cranks and enclosed single-helical gearing mounted in tapered roller bearings.

1935 By this time, slab-type counterweights were introduced. Symmetrical gear cases permitted end-for-end reversal of shafts for utilizing both sides of gear teeth.

1955 Fully adjustable counterbalanced cranks were employed with counterweights moved easily along calibrated crank rails.

The NEW *Century* Series

developed for oil's second century

The Pumping Unit with ALL the wanted features

THE "OILWELL" ALBUM at left shows some of the gear-driven, all-metal pumping units which Oil Well Supply has pioneered since the beginning of the century.

"Oilwell's" new Century Series grows out of our long experience and our intimate acquaintance with the needs and desires of well operators . . . and have every feature wanted in a unit.

Century units give you long stroke lengths. Greater stability is achieved through the use of T-shaped structural steel bases, giving a wide spread to the front legs of the samson post. New and quiet reduction gears have external streamlining for better appearance.

Your "Oilwell" representative can give you further technical information about the design of these new units, which assures you of long service at lowest cost.

USS and "Oilwell" are registered trademarks

Oil Well Supply Division of United States Steel

USS

Executive Offices: Dallas, Texas
Export Office: 30 Rockefeller Plaza, New York 20, N. Y.

Petroleum Profile

TO HIS ASSOCIATES in the Producing Coordination Department at Standard Oil Company (New Jersey), George Moses Knebel, the company's senior exploration advisor, is known affectionately as "The Explorer." The sobriquet is particularly appropriate in the space age for, like the missile with the same designation, Mr. Knebel is something of an earth-girdling satellite homing on deposits of oil.

One of his colleagues, in discussing him recently, pointed out that "not all geologists are oil-finders but Mose Knebel is the oil finder extraordinaire. He has an uncanny ability to pinpoint accumulations of oil."

For 35 years, Mose Knebel (the biblical middle name stems from his grandfather who was a preacher) has been finding oil in unlikely places for the Jersey Standard organization. Born in Waco, Texas, in 1899, young Knebel entered the University of Texas in 1918 with no money and a vague notion that he wanted to be an architect. When he found that his high school credits were insufficient for an architecture course, he was persuaded by a cousin, Floyd Dodson, also an undergraduate, to study geology. Dodson solved Knebel's financial problems, too, by making him his partner in a campus pressing service of which the younger cousin eventually became sole owner. One of Knebel's professors said he "doubtless would have been a Phi Beta Kappa man had he spent the time upon his studies that he spent in collecting clothes."

After graduation, Mose Knebel made a geological survey with Dodson, then worked for Gulf Production Company and Freeport Gulf Sulphur. In 1924 a university classmate recommended him to Wallace Pratt, then chief geologist of Humble Oil & Refining Company and later a Jersey vice president and director, who hired him. Knebel had been with Humble for six years, working principally in east Texas, when he was called to New York by Eugene Holman, another Humble geologist who had moved to the Jersey company in the first of a series of steps which would lead to his present position as board chairman and chief executive officer. Mr. Holman offered Knebel a job as chief geologist for what is now Creole Petroleum Corporation, which he accepted.

Early in his career, Mose Knebel developed a consuming interest in the habitat of oil. As a result of omnivorous reading on the occurrence and migration of oil, he developed the Knebel theory of "red flags."

"A red flag," he explains, brandishing his omnipresent western-shaped Corona cigar, "is an idea pointing to oil. It's oil in the ground saying, 'Here I am. Come and get me'."

To a Mose Knebel in search of "red flags," eastern Venezuela in the 1930's must have looked like Moscow on May Day. During his assignment there, he participated in the discovery of such fields as Roble, Santa Ana, San Joaquin, Cumarebo, Temblador, Jusepin, Pedernales and Orocual. In 1939, he returned to the United States to join Jersey's Producing Coordination Department, becoming manager of the exploration division five years later.

A voluble, informal person, one of Mr. Knebel's characteristics is an infectious enthusiasm tinged with a touch of salesmanship which he brings to bear on associates when he's bullish about a producing prospect. If one of his sales campaigns results in a significant discovery, he is apt to describe the event as "finding an elephant."

Since his appointment as Jersey's senior exploration advisor in 1958, the much-traveled Knebel has been doing even more globe-trotting. Odds are that his baggage on any trip will include equipment for hunting and fishing.

GEORGE MOSES KNEBEL

Senior Exploration Advisor

Standard Oil Company (New Jersey)

In recent years he has hunted in Lichtenstein, British Columbia, New Mexico, Texas, Wyoming, Colorado, and Newfoundland; fished off Peru and Florida (a six-foot sailfish from Florida hangs on his office wall).

Another office decoration, a globe containing waxed roses, testifies to another of his passions — gardening. Knebel and his wife, the former Carolyn Gladdish of Mart, Texas, make their home in Scarsdale, New York, where he spends evenings and weekends working in a garden of no small renown. The Knebels have two children, both married. Their daughter is the wife of Loren Kahle, Jr., son of Jersey's transportation coordinator and a petroleum engineer with Creole. Their two sons were born in Maracaibo not far from where Mr. Knebel's own son, also George Moses but called George, was born. The latter works for IBM and lives near his parents in Hartsdale, New York.

Active in many professional organizations, Mr. Knebel served as president of the American Association of Petroleum Geologists in 1955 and is a member of the Geological Society of America, American Institute of Mining and Metallurgical Engineers, Society of Economic Paleontologists and Mineralogists, Society of Exploration Geophysicists and Sigma Gamma Epsilon. He serves on the advisory board of the American Museum of Natural History and the fundamental research committee of API.

The author or co-author of several papers on petroleum geology, Mr. Knebel believes that oil in the ground "does certain things in its own rights," i.e., that there are certain physical laws controlling its occurrence and migration that man still does not know.

"I guess that makes me something of a heretic," he remarks with a chuckle. Heretic or no, Jersey Standard men feel that as long as Mose Knebel sees "red flags," the "elephants" can't be far away.

GULF AGENT 178

the anti-stalling additive proved effective by over

4 YEARS

use in millions of cars!

Your customers have sure protection against carburetor icing when you use Gulf Agent 178 in your gasoline. Gulf Agent 178 has proved itself by billions of miles of service in major brands of gasoline. It's inexpensive . . . blends readily in all petroleum products . . . and is also an effective rust inhibitor. Gulf Agent 178 can make your gasoline a better, more saleable product. Let us show you how. Write or phone.

Petrochemicals Department
GULF OIL CORPORATION, GULF BUILDING, PITTSBURGH, PA.
QUALITY CHEMICALS *from* PETROLEUM

GULF®

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

THE CONFERENCE TABLE

Business without profit is not business any more than a pickle is candy. — CHARLES F. ABBOTT

Parkinson Prolonged

We've mentioned before in these pages the best seller, "Parkinson's Law," a satire on organizations and organization men. Since it appears that the new 1959 Congress is going in for a large expansion of bureaucratic organization, we hope that you understand just exactly how Parkinson's Law works. His law is that *"Work expands so as to fill the time available for its completion,"* with two main axioms: (1) *"An official wants to multiply subordinates, not rivals"* and (2) *"officials make work for each other."*

The modern organization multiplies its administrative branch whether or not it increases its output (output may even shrink).

Symptoms of bureaucratic illness, according to Parkinson, are several. One of them is overwork, for too many administrators make too much work for each other; there is too much work to do because there are too many of them, not because there are too few.

Another illness is when an executive becomes concerned with trivial details, such as whether his pencils are sharpened or if he has a sufficient supply of paper clips. Office routine becomes an end in itself.

Result of bureaucratic strangulation is that flexibility is lost, initiative is doomed, talent withered, new ideas throttled.

In short, the organization is well on its way to death.

Parkinson's advice to business includes:

1. A business should try to establish some sort of ideal ratio between the cost of administration and production. Never increase administrative costs without increased production.

2. End conformity and introduce variety. Bring in men from the Army, bring in foreigners — men with rounded backgrounds who won't run with the herd and who are capable of changing things.

3. Remember that administration involves a great deal that is mechanical and routine, so let's reduce it as much as possible. The craftsman and the artist get much more satisfaction out of life, so let business organizations insist on more artists and craftsmen.

Part of these answers were not taken from the book by C. Northcote Parkinson, but are from an interview by Arthur Herzog, which was published in THINK magazine, the International Business Machine's company publication.

Our Creed

LEONARD REFINERIES, Inc. recognizes the American Corporation as the fourth organization of society to achieve the status of a perpetual institution, the others being the Church, the State, and the University.

WE BELIEVE that a perpetual institution has and must accept inherent responsibilities to all people.

WE BELIEVE that the Good Citizenship responsibilities of the American Corporation include developing and maintaining a climate in which there can exist:

> a constant search for ways to encourage greater creative knowledge and creative manpower; a free and competitive economy in which all people may share, as workers at fair wages, as investors at a fair rate of return, and as customers paying fair prices for quality products.

Information Tries Key

Below is a symbol to dramatize percentage depletion. Sent out by the Oil Information Committee of Texas Mid-Continent Oil and Gas Association, it is designed for use in ads, rubber stamps, postage meter slugs — any place that people may see it.

★ *In America we can say what we think, and even if we can't think, we can say it anyhow.* —Charles F. Kettering

Socony Chair Filled

Dr. Robert C. Axtmann was appointed to the Princeton University faculty as the first "Socony Mobil Professor" of Chemical Engineering for Nuclear Studies. The new chair is supported by Socony Mobil Oil Company, Inc. Dr. Axtmann will hold the rank of an Associate Professor in the School of Engineering. He is 33 years old, has been with E. I. duPont de Nemours & Company since 1950 as research physicist, nuclear reactor construction consultant, and research supervisor.

★ *A practical man is a man who practices the errors of his forefathers.* —Benjamin Disraeli

Two Lauchlin Curries

There are two men named respectively Dr. Lauchlin M. Currie and Dr. Lauchlin Currie. Both are prominent persons and have had U. S. Government service, but they are not related in any way. We suspect their viewpoints are not particularly similar.

Dr. Lauchlin M. Currie is vice president in charge of the Atomic Energy division and a director of The Babcock & Wilcox Company. He is noted for his activities in the nuclear energy field both in U. S. Government and industrial circles.

Dr. Currie began his association with the American atomic energy program in 1943 when he was selected Associate Director of War Research for the Manhattan District atom bomb project.

Distinguished abroad as well as in the United States for his activities in the nuclear energy field, Dr. Currie attended the first "Atoms for Peace" conference in Geneva, Switzerland, in 1955 as a member of both the U. S. delegation and the U. N. Secretariat.

Dr. Lauchlin Currie (no middle initial) was well known as a fiscal and economic expert and adviser in the Roosevelt and Truman administrations, and received considerable publicity in connection with probes into foreign influences on U. S. Government policies.

So the next time you see the name, differentiate between the Babcock & Wilcox Atomic Currie and the Economics Currie.

As Others See Us

"On the oil front the administration has just slapped compulsive quotas on cheap oil from abroad so as to keep up prices at home (which of course is inflationary); and by some beautiful sophistry does this in the name of 'Conservation' though it means quicker exhaustion of America's limited oil supplies. Oh well, it will keep up oil company profits, that's the main thing." (The New Republic, March 23, 1959)

★ *Big jet planes eat fuel three times as fast as conventional piston-powered planes. Each jet uses from six to seven million gallons of petroleum a year.*

Business Men in Politics

Some sarcastic remarks have been made about the effectiveness of business men in politics. It might be well, however, not to ridicule their inexperience yet. The fact that some companies have begun to see that their business and the economy of the country is so wrapped up in politics that they must face it along with business goals is one step forward. Even the Committee on Political Education (COPE) was not built in a day. Power of this official political arm of the AFL-CIO has been felt only in the last two elections. The build-up has been long and expensive.

There are a lot of high-brow analyses of the psychological effect of business men in politics, but most of it sounds as if it came from the tongues or pens of "liberal" intellectuals who would discourage the business tribe if they could. They advance the theory that the public does not take well to either labor or business injecting themselves into politics. It is true that labor has gone into politics in an organized fashion and business is certainly highly unorganized as of now. But in a free country, surely frank and sincere adherence to a principle or a candidate should be recognized and respected. Ignorance and indecision leave a vacuum in politics as quickly as in business.

★ *Battle of the sexes: Men say women can't be trusted too far; women say men can't be trusted too near.*

It Had to Come

An editor of a science magazine reports that the problem of *laissez faire* versus government spending and planning has in the past been limited to economic matters. We've seen in recent years greatly increased public funds devoted to scientific education, research, and projects. So, says this commentator, the role of the state has been broadened to include government's responsibility to science. And, he adds, "we suggest this responsibility extends to other enterprises of culture and scholarship."

You'll admit that the above has a pretty complicated aura, something you expect from a scientist. In truth, the whole piece (and there was more of it) is chillingly simple and direct. It means —

1. The State now plans and largely controls economic matters.

2. The State should be responsible for scientific education, research, and projects.

3. The State should direct and control enterprises of culture and scholarship.

Even if you have heard all this before — about another nation — you'll have to admit the man has some logic. If any State has firm fingers on economic affairs, all other controls are within its grasp.

War With the Soviet

"We are at war with the Soviet Union — economic war" said A. S. Glossbrenner, president of Youngstown Sheet and Tube Company, at a meeting of the American Iron and Steel Institute. "They mean business. They intend to win it. The steel industry of our two countries is one of the major fronts of this economic war," said Glossbrenner.

His solution to this challenge is that the industry must be in the hands of managers who are strong and who can make hard decisions without wavering.

The proper attitude, he said, cannot be built on "a foundation of the employees' ignorance of the policies and ambitions and overall goals of your companies and of this industry.

"We have got to start telling our people through official management sources as much as we can why we must increase our productivity in this crucial area. And, while we are about it, we must impress upon them the importance of management's right to manage. I still have enough faith in the American steel worker to believe that he will respond to this kind of an approach, whether he belongs to a union or not."

Glossbrenner further called for an effort on the part of steel management to combat the "division of loyalty" in the ranks of employees.

"I wonder if it has ever occurred to you," he said, "that it is the management of a company, or an industry, to whom the employees naturally look for leadership. If the employees fail to find the leadership they naturally expect, they look elsewhere. We have lost too much leadership by default."

★ *What this country needs is a good five-cent anything.*

The Way to Greatness

(The words were spoken at Valley Forge by former President Hoover to a nation facing the "difficulties and confusions" of the Space Age. The end of Mr. Hoover's speech held a dramatic surprise. He revealed to his audience that he had spoken these same words in the same spot 27 years ago, in 1931, as America faced another crisis — the Great Depression):

The nation is beset with difficulties and confusions. Many of us have doubt and grave concern for the future. But no one who reviews the past and realizes the vast strength of our people can doubt that this, like a score of similar experiences in our history, is a passing trial. From this knowledge must come the courage and wisdom to improve and strengthen us for the future.

We must not be misled by the claim that the source of all wisdom is in the Government. Wisdom is born out of experience, and most of all out of precisely such experience as is brought to us by the darkest moments. It is in the meeting of such moments that are born new insights, new sympathies, new powers, new skills.

Such conflicts as we are in the midst of today cannot be won by any single stroke, by any one strategy sprung from the mind of any single genius. Rather must we pin our faith upon the inventiveness, the resourcefulness, the initiative of every one of us. That cannot fail us if we keep faith in ourselves and our future, and in the constant growth of our intelligence and ability to cooperate with one another.

The memory of Americans who glory in Valley Forge tells us the truth which echoes upward from this soil of blood and tears: *The way to greatness is the path of self-reliance, independence and steadfastness in time of trial and stress.*

Highlights ★ ★ ★

Oil Import Directive Revised

Import restrictions on crude and products from Canada and Mexico were eased by President Eisenhower. The Canadian industry was pleased by the report and Mexico acknowledged the favored position but said it did not expect to export to the United States soon. Venezuela officials were not too happy about restrictions applying to Venezuelan exports to U. S. and rumors persisted that some changes would be made in this direction.

Revolution in Economy

Automation today is doing to manufacturing what mechanization did to agriculture during the war. Automation in oil refining has resulted in a decline of workers despite an increase in productive capacity. Since 1954 chemical industry output increased 22 percent and number employed declined 6 percent. At the same time demand for employees — and more educated employees — in services is rising. Employment in trade, banking, insurance, utilities, transportation is gaining.

Future Looks Good

An analysis of the petroleum industry's financial future was recently completed by the research department of Harris, Upham & Company, brokers. The report points out that earnings outlook for the near term is excellent and that first quarter earnings may be a record. Longer term outlook, the report says, remains good in spite of rising costs and higher taxes. Although domestic consumption has not grown as rapidly as in recent years, it is still increasing at a rate of about 30 percent better than growth in the national economy and demand abroad has been almost twice that of domestic demand.

Warning to Negotiators

The President of the United States has declared in solemn tones that the U. S. Government and its citizens have a heavy stake in the negotiations of organized labor and management over wages and prices. He suggested that if a settlement of higher wages and higher prices damages the economy the Federal Government might find it necessary to clamp on controls. A political opponent, U. S. Senator Kefauver, chairman of anti-trust sub-committee, warned negotiators that government controls might follow if management and labor set off a new round of inflation. The current wage contract in steel expires June 30.

Shell Offer for Canadian Eagle

Royal Dutch/Shell has made an offer to the stockholders of Canadian Eagle Oil Company, Ltd., to acquire all its assets. Canadian Eagle has been associated with the group in countries in the United Kingdom, in Ireland, and in Latin America. Canadian Eagle shareholders are offered two Royal Dutch and three Shell transport shares for every 12 shares they hold.

Energy Conversion Reported

First direct conversion of nuclear reactor energy into electric power — a major scientific breakthrough — was announced by University of Michigan and Los Alamos (New Mexico) Scientific Laboratory. Under the process, electric power is obtained from a nuclear reactor containing a uranium carbide source surrounded by a plasma or electrified gas made from cesium. When the reactor is turned on, atomic fission causes the uranium to have such an energy release that it turns white hot. At this temperature a large electric current is produced and is then transmitted by the gas to a collector from which it can be put into use. The technique, called a *plasma thermocouple*, eliminates virtually all but the nuclear reactor in the production of electric power from fission.

Nafco Buys Oil Firm

Nafco Oil & Gas Company, subsidiary of Nafi Corporation, purchased the properties of Oil & Gas Property Management, Dallas. The transaction involved approximately $19 million. John G. Bannister, Nafi president, stated that this is the first step in a major diversification program which calls for additional investments in the oil and gas industry. John A. Crichton, formerly president of Oil and Gas Property Management, will be president of Nafco Oil & Gas.

Failures Expand, Too

An analysis of business failures in the United States made by Dun and Bradstreet shows 1958 the year of the most failures in "Mining-Coal, Oil, Miscellaneous." According to the Dun and Bradstreet survey, 86 companies in this business failed. This is the largest number of failures shown in any one year by the report.

Domestic Crude Demand Up

Forecast of May demand for domestic crude oil is estimated at 7,190,000 bbl a day by U. S. Bureau of Mines. This is 4 percent higher than the April forecast and 9 percent more than actual demand in May 1958.

Choose Your Own Miles Per Gallon

A Standard (Ind.) automotive engineer says "If anyone is crazy enough, he can go 97 miles in an automobile on one gallon of gasoline." In fact, that's just what he did. However, the driver, Norm Esau, says "Nobody in his right mind should want to do it." The car was geared to the test and speed was set between 15 and 35 miles an hour. If you want gasoline economy, Esau recommended (1) slower starts, (2) hold down top speeds, (3) pace your car to green-light speed, (4) minimize stop-and-go driving, (5) avoid jack-rabbit starts, (6) eliminate tire-squealing stops and turns, (7) eliminate unnecessary engine idling, (8) don't race engine, (9) use the seasonally adjusted gasoline and motor oil recommended for your car.

Uranium Plant Opened

Kermac-Nuclear Fuels Corporation dedicated its uranium processing mill at Grants, New Mexico, in April. Associated in the firm are Kerr-McGee Oil Industries, Pacific Uranium Mines Company and Anderson Development Corporation. The plant, built by Stearns Roger Manufacturing Company, operates on acid-leach, solvent extraction process. In the photo, Senator Kerr, chairman of the board of Kerr-McGee, who gave the dedication address, appears to be faced with the Law West of the Pecos.

Good Wells Make Good News

A Monthly Report on Wells That Are Now Worth More

June, 1959

Acid treatments are often the most profitable way to improve the permeability and drainage area of a well. Here are four recent examples of effective acid treatments by Dowell.

- **Nolan County, North Central Texas** (Water Injection Well) This open-hole completion was between 6165 and 6359 feet in the Strawn Reef. The pay is a highly soluble lime with good porosity and low, but varied, permeability. Since permeability varies widely in a lateral direction, deep penetration seemed necessary for good results. The Dowell treatment: three 5000-gallon stages of inhibited acid, with rock salt as a temporary plugging agent and a new Fluid Loss Additive (F.L.A.*) for deep penetration. Water injection increased from 326 to 630 bwpd at same injection pressure.

- **San Juan County, Utah** (Old Oil Well) This well had been completed into four sections of the Paradox lime, from 5554 to 5650 feet. Production had declined to about 100 bopd. Dowell injected 28,500 gallons inhibited acid with demulsifiers, surfactants and Fluid Loss Additive (F. L. A.) at about 25 bpm. 492 ball sealers were used in four stages, and 300 pounds of a temporary plug were used in three stages. After clean-up, well made 38 boph.

- **Breathitt County, Kentucky** (Old Oil Well) This open-hole completion was in the fractured, vuggy Corniferous dolomite from 1985 to 2005 feet. Decline rates have been extremely rapid in this field. Formation samples analyzed by Dowell indicated that most production came from vugs and fractures. The oil-bearing formation had a permeability of less than one millidarcy. Dowell recommended Heatblast*. 1000 pounds of magnesium pellets were "fractured" into the pay in two stages. Each injection was followed by inhibited acid with demulsifying and surface tension reducing agents added. A total of 5000 gallons of acid was used. Before treatment, the well produced about 20 bopd. Three months after treatment, production was steady at 80 bopd, pumping.

- **Lea County, New Mexico** (Old Oil Well) Production had dropped in a year from 500 to six bopd. This well, into the Pennsylvanian below 9300 feet, had been treated with 500 gallons of Mud Acid upon completion. After a study of the problem, a two-phase treatment was made. A spearhead of 20 gallons of Freflo* in 2000 gallons lease oil was followed by 2000 gallons Dowell inhibited acid with a demulsifying agent added. Production was boosted from six to 300 bopd.

When you specify Dowell for acidizing, you get the benefit of more experience than you can get from any other service company. For full information, call any of the 165 Dowell service points. In Canada, call Dowell of Canada, Ltd.; in Venezuela, United Oilwell Service. Dowell, Tulsa 1, Oklahoma.

*Dowell Trademark

Services for the oil industry DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

Highlights ★ ★ ★

Eastern Hemisphere Demand Slows

A slower growth rate in demand for petroleum products in the Eastern Hemisphere is seen during the next five years by the First National City Bank of New York. A study prepared by the bank points out that both consumption and production have grown at a faster rate in the Eastern Hemisphere since 1953 than in the West. Because of increasing competition in the market-place and increasing payments to producing-country governments, the seven major international oil companies have had to cope with declining profits from their operations in that area, the bank said.

Ethiopia Awards Concession

A new exploration agreement has been made by the government of Ethiopia and Gewerkschaft Elwerath. The concessions cover the eastern part of the country. Sinclair, which had a concession beginning in 1945, relinquished it in 1957 after extensive exploratory work, including several wells drilled.

Records Made by Firms

The Royal Dutch/Shell group and British Petroleum Company have outstanding financial reports for 1958. Production, sales and earnings were at all time high for the BP group. Net income rose to $176 million, 15 percent above 1957. Capital expenditures were $356 million.

Royal Dutch/Shell had a lower net than in 1957 but sold 5 percent more products than in 1957. Lower prices cut net profit by 29 percent to $392 million in 1958.

Urges Tariffs Over Quotas

Sun Oil Company renewed its proposal to bring about a reduction in foreign oil imports through the imposition of appropriate tariffs as a substitute for the current mandatory quota restrictions. Sun's president, Robert G. Dunlop, urged this course of action "as necessary to avoid current Federal policing of oil prices," which he said "may lead to further controls over the pertoleum industry."

Approve Signal-Bankline Merger

Stockholders of Signal Oil and Gas Company and Bankline Oil Company voted to merge the two firms. Samuel B. Mosher will remain chairman and chief executive officer; Russell H. Green will continue as president; L. L. Aubert, Bankline president, will be a vice president and director, and S. A. Patterson, Bankline vice president, will be a vice president. The company now includes Bankline's reserves and 10,000 b/d refinery at Bakersfield, which is scheduled for expansion.

Gasoline Taxes Diverted

A substantial portion of federal and state gasoline taxes continues to be diverted for uses other than road-building, R. W. McDowell, president of DX Sunray, told civic leaders in Oklahoma. "Not only does a substantial amount of gasoline tax find itself diverted into uses other than the building of roads, but diversion of this tax money is increasing more every year." He said the promise of more and better roads "loses its sincerity when we look back and see what has happened to other tax increases for which we were promised more and better roads."

Gulf Employees Reject Union

Clerical employees of Gulf Oil Corporation, Philadelphia Sales Division, voted by an overwhelming 10 to 1 margin to reject the Oil, Chemical and Atomic Workers International Union-AFL-CIO as their bargaining agent. The employees voted 360 to 35 to reject organization.

Russian Crude Delivered

By a new contract a Norwegian tanker arrived at Wilhelmshaven, Germany, with a load of 19,000 tons of Tuimasa crude from Novorossiysk. This is the first delivery of Russian crude to Western Germany effected in the postwar period under a barter contract in exchange for German rolling mill products. Altogether 150,000 tons of Russian crude are to be imported and refined at Scholven-Chemie AG. The oil is to be pumped to Gelsenkirchen through the newly laid pipeline. — *Erdoel-Informationsdienst*, Hamburg, Germany.

IPE Great Show

Consensus of visitors to the International Petroleum Exposition at Tulsa, Oklahoma, was that it was the best one ever presented. Electronics and the most powerful equipment ever displayed were twin stars of the show. The viewers glimpsed a future of new and spectacular operations in an expanding world industry.

Meetings

June 15-17—**Interstate Oil Compact Commission**, midyear meeting, Roosevelt Hotel, New Orleans, La.

June 22-24—**Canadian Gas Association**, annual meeting, Empress Hotel, Victoria, B. C., Canada.

June 24-25—**Western Petroleum Refiners Assn.**, Mid-Continent regional technical industrial relations meeting, Broadview Hotel, Wichita, Kan.

Aug. 9-12—**ASME-AIChE**, heat transfer conference, University of Connecticut, Storrs, Conn.

Aug. 10-13—**Society of Automotive Engineers**, West Coast meeting, Hotel Georgia, Vancouver, B. C.

Sept. 15-17—**Texas Mid-Continent Oil & Gas Association**, annual meeting, Rice Hotel, Houston, Tex.

Sept. 16-18—**National Petroleum Association**, annual meeting, Traymore Hotel, Atlantic City, N. J.

Sept. 20-23—**American Society of Mechanical Engineers**, petroleum mechanical engineering conference, Rice Hotel, Houston, Tex.

Sept. 23-24—**Western Petroleum Refiners Association**, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

Sept. 27-30—**API**, executive committee of board of directors, Greenbrier Hotel, White Sulphur Springs, W. Va.

Sept. 28-Oct. 1—**The American Welding Society**, fall meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

Sept. 29-30—**Western Petroleum Refiners Association**, management seminar, Western Hills, Wagoner, Okla.

Oct. 4-7—**Society of Petroleum Engineers of AIME**, annual fall meeting, Dallas, Tex.

Oct. 5-7—**American Gas Association**, convention, Conrad Hilton Hotel, Chicago, Ill.

Oct. 7-8—**Western Petroleum Refiners Association**, annual waste disposal and pollution conference, Broadview Hotel, Wichita, Kans.

Oct. 8-9—**California Natural Gasoline Association**, annual fall meeting, Huntington-Sheraton Hotel, Pasadena, Calif.

Oct. 11-15—**American Society for Testing Materials**, committee D-2 meeting, Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 16—**Natural Gasoline Association of America**, southern regional meeting, Carlton Hotel, Tyler, Tex.

Oct. 22-23—**Society of Petroleum Engineers of AIME**, Los Angeles Basin section, fall meeting, Huntington-Sheraton Hotel, Pasadena.

Oct. 26-27—**Independent Petroleum Association of America**, annual meeting, Statler-Hilton Hotel, Dallas, Tex.

Oct. 28-29—**Western Petroleum Refiners Association**, annual session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

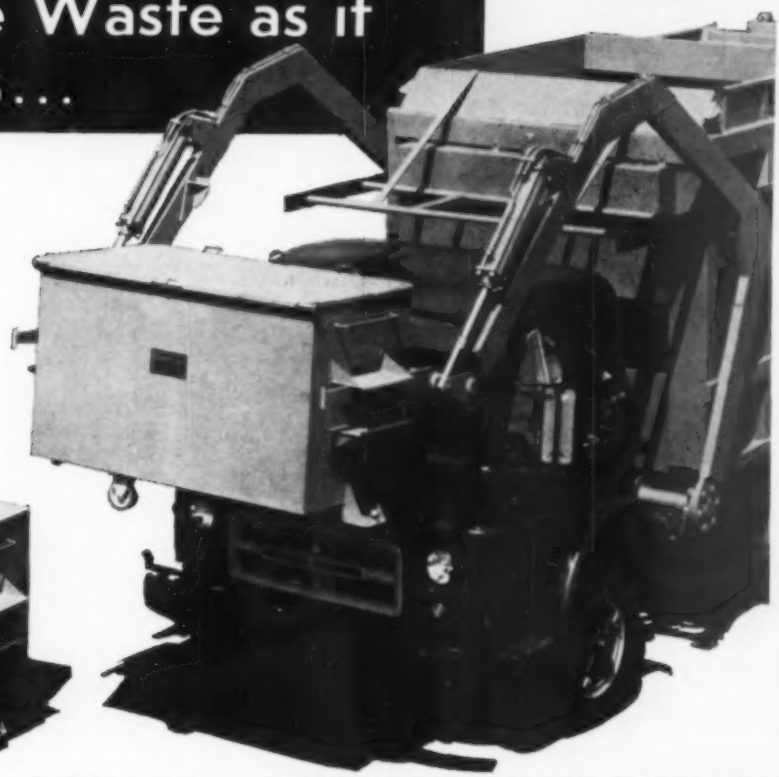
Oct. 28-30—**Society of Automotive Engineers**, national fuels and lubricants meeting, La Salle Hotel, Chicago, Ill.

Oct. 29-30—**Southwest Section of the AIME and Texas Petroleum Research Committee**, Oil Recovery Symposium on Southwest Texas, Driscoll Hotel, Corpus Christi, Tex.

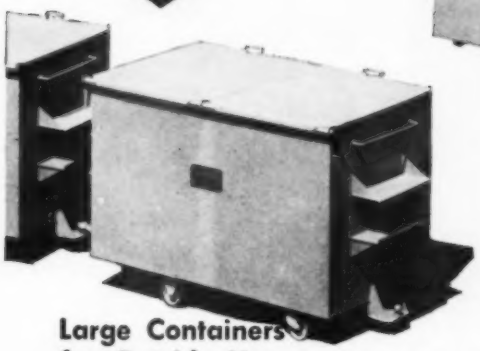
cut disposal costs by two-thirds...

Containerize Waste as it Accumulates...

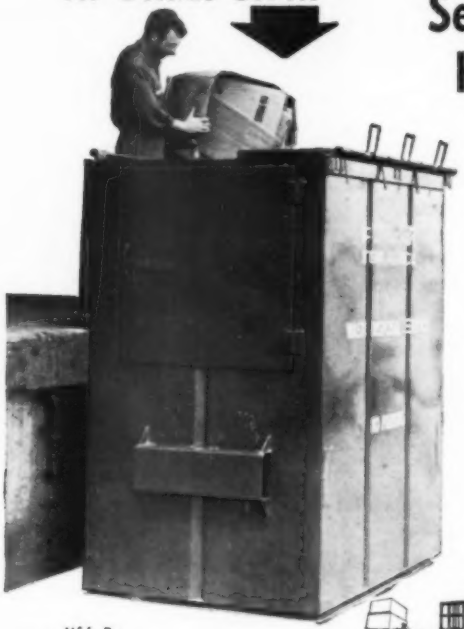
Patents Pending



Small Tracking Containers for Indoor Use...



Large Containers for Outside Use...



Mfd. By DEMPSTER BROTHERS Inc.

Self-Loading DEMPSTER-DUMPMASTER Handles 6 Sizes of Containers...

If you're using boxes, bins, cans or carts to handle or store big-volume waste and refuse, you can reduce costs by more than two-thirds with the new DEMPSTER-DUMPMASTER System of waste storage and collection.

One Dumpmaster serves any number of detachable metal containers placed at waste accumulation points. Making its rounds, the Dumpmaster picks up each container, in turn, empties the contents into its packer body and compresses the material to a fraction of its former volume assuring big pay loads on every trip to the disposal area.

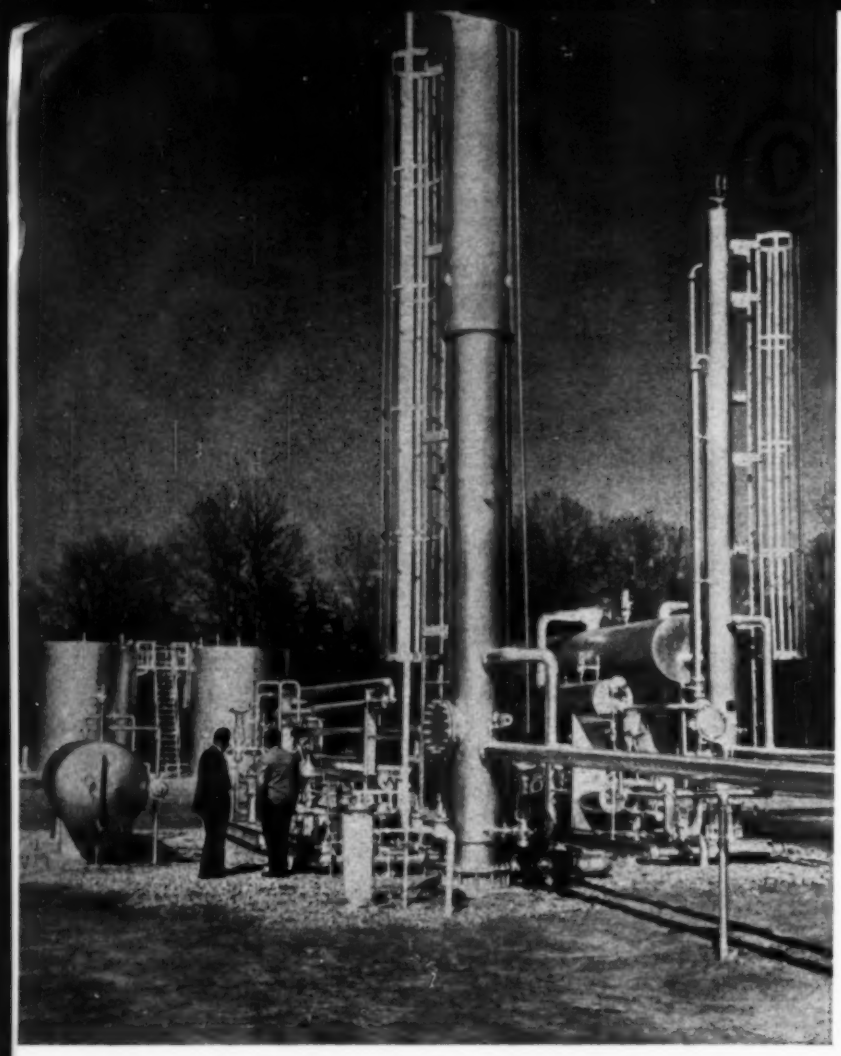
The DEMPSTER-DUMPMASTER is economical! One man operation. It's safe! Clearance lifting arms never pass the cab windows, can't injure operator. Containers can be used indoors or outdoors, on ground, below grade or on a dock.

This system is also available on a monthly fee basis through a nearby DEMPSTER-DUMPMASTER equipped private hauler, (name furnished on request).

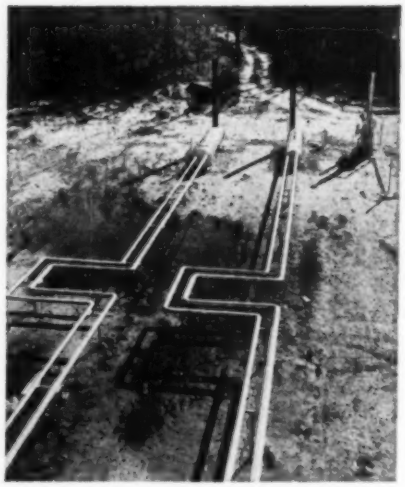
WRITE TODAY FOR FREE BROCHURE

DEMPSTER DUMPSTER® SYSTEMS

Dept. P-6 DEMPSTER BROTHERS, Knoxville 17, Tennessee



BS&B "COLD-FRAC" BOOSTS CONDENSATE RECOVERY BY 39%!



This BS&B 5GDH "COLD-FRAC" with a 25-ton BS&B Ammonia Absorption Refrigeration Unit, owned by W. E. Hall, H. M. Harrell, D. B. McConnell, et al, was recently put into service at Stinson #1, Sligo Field, Bossier Parish, North Louisiana. The unit is recovering slightly more than 74.5 bbls. of condensate per MMSCF/D — an increase of over 39% from the 53.5 bbls. per MMSCF/D recovered on standard separator test.

Operating conditions are as follows:

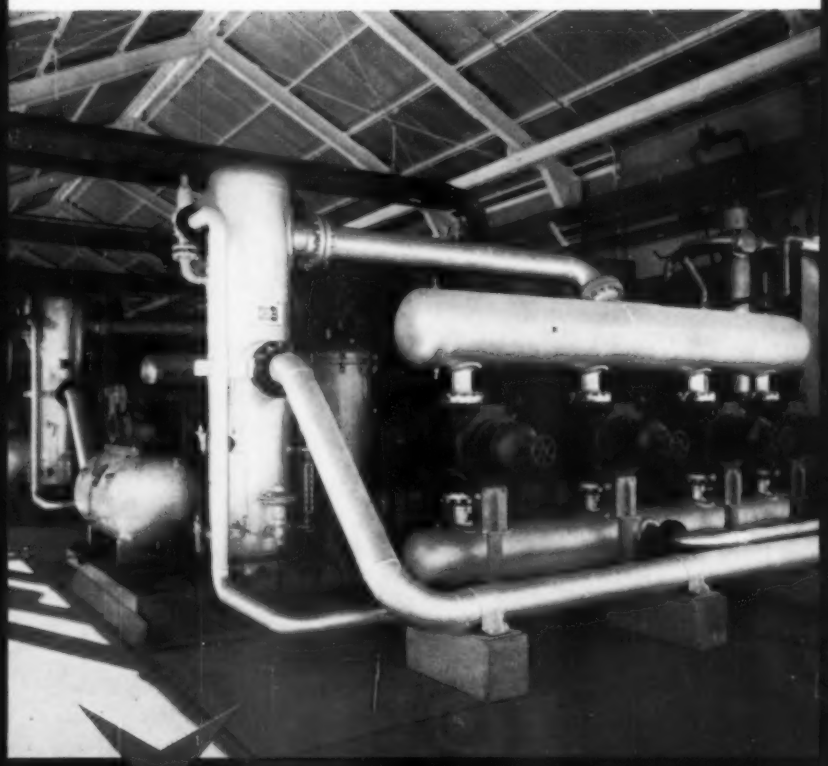
Flow	4.7 MMSCF/D
Inlet pressure	1350#
Inlet temperature	150° F.
Sales pressure	700#
Low temperature separator	0° F.
GDH stock tank recovery	74.5 bbls. per MMSCF/D
Standard separator test (600# at 70° — stock tank recovery)	53.5 bbls. per MMSCF/D

Your nearby BS&B man will be glad to work out details with you on a similar installation tailored to your lease requirements. He reasons that profit for you is good business for him — put him on your team today!

BS&B

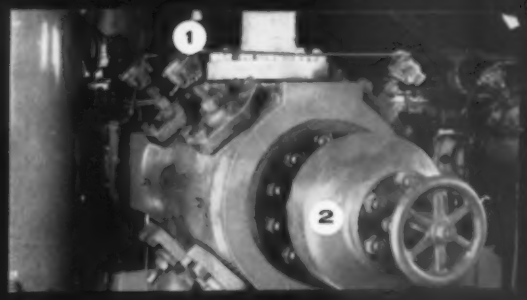
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC., DEPT. I-C6 P. O. BOX 1714, OKLAHOMA CITY



4-CYCLE DESIGN

INCREASED FLEXIBILITY FOR UNATTENDED STATIONS



COMPRESSOR CYLINDERS have (1) automatic inlet valve unloaders and (2) fixed volume clearance pockets. Valve unloaders are combined with automatic engine speed regulations to provide smooth loading and unloading while maintaining desired pressure conditions.

CONTROL CENTER with (1) AS&P controller (2) Engine gauge panel (3) Crankcase oil level valve (4) Three-way oil temperature control valve (5) Triflo four ported oil valve (6) Scrubber liquid level shutdown switch

660 H.P. BEAIRD-INGERSOLL-RAND packaged compressors in an automatic, unattended gas boosting station. Units are equipped for unattended operation with speed and pressure regulation. Interstage and after cooling sections are mounted in the Young updraft design radiators. Other Beaird compressors available from 120 to 660 h.p.

Complex or partial control systems will not meet the requirements of a modern, automatically operated unattended compressor station. This is why leading operators select Beaird-Ingersoll-Rand 4-cycle packaged compressor for this service.

The 4-cycle design provides smooth power at any load (even with frequent variations), and at any engine speed from full to half. To meet even greater line variations compressor cylinders can be loaded or unloaded in steps from full to no load. Should conditions require the unit to stand by, the 4-cycle engine can be idled for long periods without carbon build up or damage to the valve ports. This is possible because the constant quality fuel mixing valve will handle all speed and load conditions.

Lowest cost per horsepower to install, Beaird-Ingersoll-Rand packaged compressors require minimum foundation and piping . . . can be easily moved to other service.

Beaird gas engineers are available to assist you with your plans on automatically operated field stations.

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana
A Subsidiary of American Machine & Foundry Company

CHECK THESE EXCLUSIVE 4-CYCLE FEATURES:

Complete engine speed control
Line pressure maintenance by speed regulation
Gas capacity control by speed regulation
Constant quality fuel mix ct all speeds
Long spark plug life
Idling for long periods
Small, accessible air intake piping
One air intake and one exhaust connection
No scavenging air manifolds or piping required

another AMF BEAIRD product

SALES OFFICES: Shreveport, New Orleans, Louisiana • New York, New York • Tulsa, Oklahoma • Houston, Corpus Christi and Midland, Texas and Cie. Ingersoll-Rand, Paris, France.

BEAIRD INTERNATIONAL, INC. SHREVEPORT, LOUISIANA • Sales Offices: Calgary, Alberta, Canada • Caracas, Venezuela.

Expansion of Knowledge Aim of World Petroleum Congress

An Interview with E.V. Murphree Chairman of the Congress

Q. When does the Congress open, where is it being held and how long will it last?

A. The opening meeting is being held in the Grand Ballroom of the Waldorf-Astoria Hotel, New York, on the afternoon of Sunday, May 31. This meeting will last approximately one hour and will be followed by a reception for all Congress registrants and their wives. The main technical sessions of the Congress are scheduled to begin in the New York Coliseum the following morning and will continue through Friday, June 5. During that period there will be approximately 100 sessions, each lasting a half day.

Q. How is the main technical program being organized?

A. It has been broken down into 10 sections each dealing with a specific oil industry function. These sections cover geology and geophysics; drilling and production; oil processes and refining; petrochemicals; composition, analysis and testing; utilization of petroleum products; engineering, equipment and materials; transportation and distribution; operations research, statistics and education; and the uses of atomic energy in the petroleum industry.

Q. Has each section drawn about the same number of papers or has any one of them attracted more attention than the others?

A. As may be expected with the continual and widespread search going on for new sources of crude supplies, Section I, dealing with geology and geophysics, has by far the greatest number of papers. Fifty-six are being presented in this section, and with the 31 which have been written on drilling and production, papers covering these topics make up nearly a third of the main technical program.

One of the most interesting things about the geology and geophysics papers is that they deal with some 33 widely scattered areas around the globe, including the new fields in the Sahara.

Q. Are there any special features about the Congress which you would like to mention?

A. Yes, there are. The first is that while papers on the use of atomic energy in the petroleum industry have been given at past Congresses, the Fifth Congress is devoting a complete section to this topic. Eighteen papers are scheduled for presentation, including one on the probable impact of atomic energy on the world petroleum industry and another on the peaceful uses of atomic explosives.

Another special feature is that an exposition has been organized as an integral part of the Congress activities. It is being held at the Coliseum on the two lower floors and it will display the latest equipment.

Q. May we have a few details about the history of the Congress. For instance, when was the organization first established?

A. The World Petroleum Congress is now over a quarter-century old. It was founded in London in 1933, when the first Congress was held there. Four years later, the second meeting was held in Paris and it was there that the Permanent Council of the Congress was established. The Council is the central policy-making body whose responsibility it is to ensure the continuity of the Congress, pick the locations for its meetings and see to it that the high technical standards of the Congress are maintained.

The third meeting of the Congress was being arranged when war broke out and it was not until 1951 in The Hague that the meetings got going again. The Hague meeting was followed by one in Rome in 1955.

Q. Why was the U. S. picked for the Fifth Congress?

A. The U. S. oil industry thought it might be appropriate if the Congress were held here this year to coincide with the 100th anniversary of the birth of our industry, and the Permanent Council accepted the invitation to this effect which was extended by Mr. Frank Porter, President of the American Petroleum Institute, at the Rome Congress.

Q. Why was it thought necessary in 1933 to establish the World Petroleum Congress?

A. At that time there were many problems confronting the industry and it was thought that an international exchange of scientific and technical operations information and ideas on these problems would be advantageous to all concerned.

This has certainly proved to be the case as the

E. V. MURPHREE, chairman of the Permanent Council of the World Petroleum Congress, has been president of Esso Research and Engineering Company since 1947. He is also chairman of the Fifth World Petroleum Congress, Inc., the corporation established in the United States to handle organizational details for the New York meeting.

An internationally recognized authority on petroleum science, Mr. Murphree has also been prominent in the development of Atomic Energy. He has long been a member of the General Advisory Committee of the United States Atomic Energy Commission and also served as special assistant to the Secretary of Defense on Guided Missiles.

Mr. Murphree, who holds a master of science degree in chemistry from the University of Kentucky was awarded the Perkin Medal for work in applied chemistry in 1950 by the American Section of the Society of the Chemical Industry and, three years later, the Industrial Research Institute presented him with an award for outstanding accomplishments in the organization and direction of research.

He is a member of the National Academy of Science; of the American Institute of Chemical Engineers and the American Chemical Society.

---

increasing support given the Congress by the oil industry over the past 25 years most clearly indicates.

Q. Have the problems that existed then been added to as the years have passed?

A. Yes, indeed they have. But research, now an important component of the industry, is being relied on to solve them, and the exchange of information is proving most helpful in this connection. The importance of research is shown by the fact that last year approximately $300 million was spent on all branches of petroleum research in the U. S. alone.

Q. When was petroleum research established on an organized basis?

A. Many companies started setting up research departments in the 1920's. In recent years research has proved so valuable to companies that it has been expanding at a steady rate of about 12 percent a year.

Q. Regarding the use of atomic energy in the oil industry, are projects still largely in the experimental stage or is atomic energy being put to practical use?

A. The use of nuclear radiation in the petroleum industry is still very much in its infancy but, as you know, the industry has been quick to see the possibilities of using radiation to solve many of its problems, particularly those encountered in exploration, production and refining. For example, there is a project being given consideration right now dealing with underground thermal-nuclear explosions to produce oil from Colorado shale. A similar process is being discussed to release oil from tar sands in Alberta.

As I am sure you know, at least 14 U. S. oil companies have large-scale radiation programs underway or planned and already nuclear energy is bringing big returns to the petroleum industry in the U. S. For instance, it has reportedly been estimated by the Atomic Energy Commission that oil refineries have saved from $5 to $10 million a year through the use of radioisotopes and that radioactive tracers used in connection with oil well stimulation have produced savings of as much as $120 to $140 million.

Q. What subjects are the Congress papers in the atomic section concentrating on?

A. Besides the general paper on the probable impact of atomic energy on the world's petroleum industry and the paper on the peaceful uses of atomic explosives, which I mentioned earlier, there will be studies on the use of atomic physics in oil prospecting; the technical and economic prospects of nuclear energy in the petroleum industry; the use of radioisotopes in fuel and lubricant research; the way in which chemical reactions — vital to modern refining and petrochemical manufacture — are affected by radiation; and the lubrication requirements of nuclear power plants.

Q. Mr. Murphree, as president of a research company, we would like to ask you for your views on the value of research and scientific meetings such as the Fifth World Petroleum Congress.

A. I will digress a little, if I may, in answering this question. First, I would like to say that man is striving, perhaps not always consciously, for a better way of life for his family and himself and for those whom he holds dear. It is safe to assume that unless there is a catastrophic occurrence, science will one day conquer disease, proverty, and hunger, at least to a major degree. We will probably be able to control the weather and have supplies of cheap energy from sources yet untapped or undreamed of. Probably in a few decades, some space travel will be commonplace and communications, transportation and housing will be so vastly improved as to bear little resemblance to what we know today.

These are exciting thoughts and they are in the realm of possibility if science continues to make the rapid strides it has over the past few years. The main problem is that to achieve these ends will require a tremendous increase in our storehouse of scientific and technological knowledge — and most of this increase must be in basic fundamental knowledge. To acquire this knowledge, I feel that we who are engaged in the search for it must reappraise our organizations, our methods, our procedures.

You will agree, I am sure, that the best ideas in the world are completely worthless if they remain imprisoned in their creator's brain. Consequently, research and scientific forums such as the Congress have become a very important phase of our advanced learning activities. To assist the research man in the expansion of his knowledge he must be provided with time and opportunities to discuss with his colleagues ideas, information and scientific data. The World Petroleum Congress was created to this end and has made an extremely important contribution. ★ ★ ★

World Industry Attains Records — *Slowly*

Petroleum production, consumption, refining capacity and runs reach their highest mark in 1958 but increase lags behind recent years . . . USSR has steep rise in consumption and expansion in all operations . . . Another year of worldwide records predicted for 1959 . . .

Ernestine Adams

Even with an economic recession in many countries in 1958 the petroleum industry of the world managed new records in consumption and in all its operations. It did slow down. But it appeared to be only a breathing spell before the next steep climb.

Production world-wide, including Communist countries, plodded ahead of 1957 by only 2 percent but consumption saw a rise of 5 to 6 percent. The discrepancy is mostly accounted for by the U. S. drop in production and use of stocks. U. S. domestic demand had slightly less than a 2 percent rise. The USSR reported a 15 percent increase in consumption.

Refining capacity expanded by 7 percent but runs increased by only half that amount.

Exploration scarcely paused. The Sahara was invaded by international geological and geophysical teams spotting sites for the drilling crews that followed. Oasis Oil (Ohio, Amerada, Conoco) discovered oil at the first test well in Libya, a happy event that seldom occurs in such exploratory operations.

Alaska, the new 49th state but still a territory at the beginning of 1958, showed new evidence of oil resources.

Africa may be teeming with political unrest, as the political reporters say. It is also swarming with oil seekers, who explored its east and west coasts as well as the Sahara.

Political instability made a queasy foundation for exploration in many areas. Some countries, however, held to their oil codes despite statists opposition and gained the capital they needed for development of oil resources.

The year 1958 produced no big dramas — like the nationalization of Iran's oil industry in 1951 and the Suez Canal closure in 1956. No conflict — like the Korean War — brought unforeseen demands.

The year had some startling acts, however. Argentina's approach to its petroleum development was surprisingly well received. If Argentina's resources are not too optimistically evaluated, oil companies may do well with the contracts they have. No concessions were awarded on Argentina land but the State contracts to buy production at set rates and makes contracts for other services.

Venezuela's retroactive income tax threw a spanner in the operations there. The outgoing Junta, one member of whom was defeated for president, lowered its boom before the elected president, who had promised something on the same order, was inaugurated.

A year ago we stressed the oil competition of the Soviet and its subsidiaries. The situation now is still better evidence of its expanding supplies. The new decentralized area development program has given the Soviet petroleum industry an impetus it has not had since the Revolution. The effort is only beginning. The vast territory of the USSR has double the potential of the USA. Its capacity for expansion is virtually unlimited. The Soviet government has awakened to the urgency of capital in petroleum expansion and has allotted $43 billion for the Seven Year Plan. The list of pipeline projects alone (which we will publish) is proof of the Soviet's plan to distribute petroleum energy to the four corners of its country.

At present the USSR consumption is low in comparison to some nations of the Free World but its gains in demand have averaged 15 percent a year for five years.

Oil is the Soviet's best trading medium except for gold and it makes good use of trading, principally in crude or fuel oil. It sells to European countries, Far East, and South America for whatever it can get in exchange. It is interesting that Belgium, in a recession in 1958, had a high increase in petroleum products consumption. Principal reason seems to be Russian imports of fuel oil at low cost.

There is no question that 1959 will see new high figures for petroleum activities — a greater rise than in 1958 over the previous year.

In 1958 potential supply of petroleum was ahead of demand. This occurs in years of comparative stability. In an uncertain world, the petroleum industry must lift its mountain of supply on Atlas shoulders and hope that economic progress alone will lighten the load.

Miss Adams is Management Editor

EDITOR'S NOTE: Figures are average for 1958 unless otherwise stated. R. C. — Crude refining capacity. Runs — Crude runs to stills. (?) — Indicates information slight.

ADEN

R. C. 120,000 b/d
Runs 78,000 b/d

The new 20-mile gas pipeline between BP's Aden refinery and Aden Electricity Department's power station has been completed. The refinery will supply up to 15,000 tons of fuel gas a year through a new pipeline to replace fuel oil for firing the power station's boilers. The 6-in. pipeline, buried over the greater part of its length, was laid by local contractors.

BP has the only exploration license. Consumption is about 1000 b/d.

AFGHANISTAN

Swedish drilling contractors are on the third test in Angut, in the north part. The government has accepted a proposal from the Soviet to supply equipment and technicians in the exploration project.

ALASKA

The big spurt in oil activities reported for 1957 has continued to grow through the year 1958. At the close of the year, 23 million acres of land were under oil and gas lease and another 17 million acres under offer or application. Leases were being processed by the Bureau of Land Management at the rate of 2 million acres per month.

During the year six wells were drilled, five of which were declared non-productive. Two of the non-productive wells had promising gas shows, but were too far removed from a possible market to be of economic importance. The one well declared productive was the Swanson River Unit Well No. 2 relatively close to the 1957 discovery well. This operation is being conducted by Standard Oil of California in cooperation with Richfield Oil Corporation.

Other companies drilling were Colorado Oil and Gas, Humble Oil and Refining, and Anchorage Gas and Oil Development. At the close of the year 2 additional rigs were enroute to Alaska with plans to spud in 2 new wells early in 1959. This would make 7 rigs in the state.

In addition to many geologic field parties (probably 25), geophysical prospecting was conducted throughout the year by Humble, Union-Ohio, SOCAL-Richfield, and Great Basins-General Petroleum. Eighteen major oil companies are active in field exploration and leasing in Alaska. The majors are joined by 15 other small companies or independents in this activity.

A portion of the geologic province north of the Brooks Range was open to mineral leasing during 1958, which area included the only proved structure in Alaska at that time known as the Gubik gas field. A large percentage of the 4 million acres offered by the Department of the Interior was taken up. Development of the Gubik field by private enterprise is scheduled for early 1959.

No activity in the field of pipeline construction or refinery installation was in evidence.

Consumption in Alaska runs 15,000 b/d.

ALBANIA

Prod. 8000 b/d **R. C. 6000 b/d**
Runs 6000 b/d

Last reports from this Communist satellite is that production dropped from 10,000 in 1957 to 8000 b/d in 1958. Our guess for 1957 was 7000 b/d, which was evidently underestimated.

Cerrik and Stalin City refineries have combined annual capacity of 6000 b/d, believed to be about equally divided. These are by far the largest refineries in Albania and account for most of the refining capacity. Cerrik plant is being expanded further.

Here is a condensation of what the USSR Neftyanoye Khozyaystvo in 1957 published about Albania's operations:

"After World War II the Soviet Union and the other people's republics helped Albania rebuild its petroleum industry. Albania received heavy drilling rigs, mobile drilling rigs, turbodrills, pumping jacks with reducing gear, rod-type deep well pumps, dynamographs, depth manometers, and sounding devices. This equipment made it possible for Albania to increase its oil production 100 to 220% from 1951 to 1956. Albanian oil production in 1956 was several times higher than in prewar years.

"Exploratory drilling has increased since 1954 and it amounted to 72,000 ft in 1956. Most of the exploratory drilling is being carried out in the Patos oilfield. During exploration of Pekisht in 1956, high grade petroleum was found at a depth of 1700 ft. Proximity of this oilfield to the refinery and the high grade petroleum in its shallow wells make it worthwhile to continue exploration of this area. A department of exploratory drilling was organized in March 1957 and it is expected that during the second Five Year Plan the footage of exploratory drilling will exceed nearly two times that of the first Five Year Plan.

"The drilling department consists of 16 drilling and 6 derrick-building crews. The formation rocks are soft and are usually drilled with RKh bits. The main oilfields are Kucove and Patos. The Driza-Patos formation in the Patos oilfield is being developed. Above this formation is the Goran formation where the oil is of an asphaltic base and of very high viscosity. The Patos oilfield produces 83% of the petroleum in Albania. Greater production is usually achieved by drilling new wells since application of secondary recovery methods has not been decided on.

"At the Kucevo oilfield many of the low-producing wells (1 b/d) are exploited with deep well pumps and some of the wells by bailing. The new refinery and the rebuilt one still process the entire Albanian petroleum production, producing asphalt, tractor kerosine, diesel fuel, gasoline, solvent, lubricating oil, naphtha soap, and grease.

"The staff of petroleum engineers and technicians was trained in the Soviet Union and in other people's republics. The technicum and vocational school of the petroleum combine trains the personnel required by the Albanian petroleum industry. There is an exchange of economic, scientific, and technical information on petroleum between the Soviet Union and Albania and other people's republics."

Consumption is around 5000 b/d, the surplus crude and products being exported.

ALGERIA

Prod. 8500 b/d

Hottest spot for oil activity in 1958 was in the Sahara. Operations in North Algeria were quiet but boom action moved across desert sands in the south.

New foreign capital flowed into the area when additional exploration permits were granted to 12 groups of companies representing, in addition to French capital, American, Canadian, Italian, British, and Netherlands capital.

Petroleum research concessions have been granted to these companies by a series of French decrees published in the Journal Officiel de la Republique Francaise, No. 203, of August 30 and November 22, 1958.

The duration of newly granted permits is 5 years. The required minimum investment varies from area to area between 450 million francs (about U. S. - $1,050,000) and 2850 million francs (about $6.8 million).

Various non-French companies have already been participating in Sahara exploration work for a number of years.

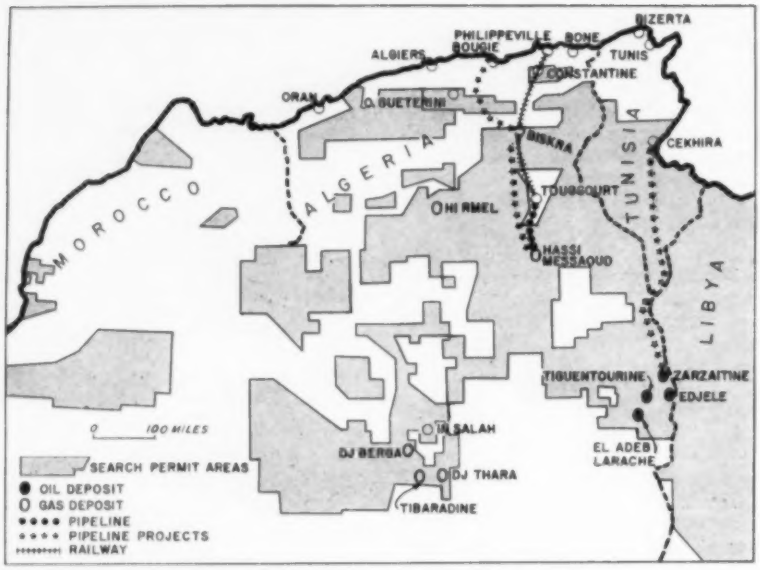
See table for exploration permits.

Operators are exempt from import duty on industrial equipment and materials and may import freely if like goods are not available from French sources.

Exploration. A geological study of the Sahara shows certain land structures that might indicate the presence of oil. Four areas have been singled out:

1. The sedimentary Sahara basin, limited on the north by the Atlas, on the west by the Saoura region, on the south by the crystalline Hoggar massif, and on the east by the Lybian and Tunisian borders.
2. The Tindouf basin.
3. The Taoudeni basin.
4. The Sudan-Niger basin.

Only the Sahara basin has been fairly systematically prospected.



Recent map of North Africa and Sahara Desert, showing concession areas in grey.

Since 1955, important gas deposits have been discovered at Djebel Bergha, En Bazzene, Thara, Tibaradine, Djaret. In all, this region around In Salah is already capable of producing approximately 35 million cu ft per day, even though prospecting and drilling is far from being finished. This figure must yet be tripled before a pipeline could be built to transport the Sahara gas over the hundreds of miles required.

Still more encouraging results were forthcoming in 1956, including oil production. The Edjele well (CREPS) brought to light the first really important traces of oil from 4842 ft. The well has a potential of 4000 b/d of oil. In the same area oil was found at Tiguentourine and Zarzaitine.

Farther north, around Ouargla, the Hassi Messaoud well (S. N. REPAL) found rich reserves.

Oil reserves have reached almost 7 billion bbl, about two-thirds at Hassi Messaoud.

There are 118 wells now producing and drilling, 38 rigs are in the country. In 1958, 140 wells were drilled with 86 productive.

Exploration has been intensified. Ten geological crews were working and 32 geophysical crews were in the field, except during the summer.

Pipelines. Key to Sahara oil at the moment is pipelines. Last January the first oil from Hassi Messaoud was moved via a temporary 6-in., 124-mile pipeline to Touggourt and thence 250 miles by rail to Philippeville. The crude is shipped from this Mediterranean port to France.

Construction is going on of a 24-in. crude oil line from Hassi Messaoud direct to Philippeville, which has a capacity of 290,000 b/d. It will be completed this fall. Another line is planned from Edjeleh, Tiguentourine and Zarzaitine fields. Plans to build a new 40,000 b/d refinery near Algiers was announced by Soc. de la Raffinerie d' Algier (Beryl Algérie, CFP CFR, Mobiloil Francais, Soc Francaise des Pétroles B.P., Shell de'Algérie and Jersey Standard).

Consumption in Algeria has inincreased 21 percent, averaging 14,500 b/d in 1958.

Some of the principal operators are listed in Table 1.

ANGOLA

Prod. 2000 b/d **R. C. 2200 b/d**
Runs 2200 b/d

Two companies are exploring Angola, Tetrangol (Angolan government and Petrofina) and Cabinda Gulf Oil (Gulf). Tetrangol has already been successful in finding oil near Bemfiza and Luanda.

There are now 12 producing wells in fields along the coast line. At the present time 5 drillings rigs are operating and so far 52 wells have been drilled. Surface geology is about to be completed and seismic work is active with one crew, which made 1100 miles of profiles in 1958.

Highlight of the year in Angola was the opening of a new refinery by Lobito Purifina. It has been running at full capacity since mid-year. It takes Luanda crude and the rest imports. Runs at the refinery fill about two-thirds of the Angolan demand, or about 3500 b/d.

A rough estimate of reserves is 6 million bbl.

ARGENTINA

Prod. 98,380 b/d **R. C. 217,600 b/d**
Gas 100 m³cf/d **Runs 215,000 b/d**

Argentina tight wire situation has gradually taken on an air of permanency. President Arturo Frondizi has held off strikes and disorders with one hand and coaxed private and government capital with the other.

Oil company contracts are for service only. No concessions are granted. All companies finance their own operations but operate under the Yacimientos Petroliferos Fiscales, the nationalized company. They are paid for their service on a unit basis when and if they produce oil.

Many have been perplexed at the number of private oil firms which have taken on service contracts in a rather uncertain political-economic situation. On the other hand a strike in Mendoza showed opposition to the contracts because they were considered an infringement of sovereignty. Members of the Argentine Engineers Association objected because they believe foreign companies are allowed too much for costs of production in the contracts.

This is a small idea of the rough road of running an oil industry by politics. YPF officials point out that the company manages the industry. The gov-

TABLE 1. ALGERIAN EXPLORATION PERMITS

Operator	Principal Owners	Area (sq. miles)
S. N. REPAL	(Government of Algeria, BRP)	58,000
CFP		32,000
CPA	(Royal Dutch/Shell, SOGERAP)	40,400
CREPS	(Royal Dutch/Shell, RAP, SOGERAP)	33,000
CEP	(BRP, etc.)	45,000
CAREP	(Algerian Gov't, S. N. REPAL, BRP)	1,200
COPEFA		2,200
PETROSAREP		1,500
SAFREP		27,000
SNPA		3,000
SPV		6,000
S. N. REPAL-FRANCAREP-EVRAFREP		800
COPEFA-OMNIREX-PHILLIPS		4,000
PREPA-FRANCAREP-AFROPEC (Cities Service)		4,000
PETROPAR-Ausonia Mineraria		730
PETROPAR-FRANCAREP-FRANCO-DELHI		700
PETROPAR-PAN AMERICAN-FRANCO-WYOMING		1,000
SAFREP-SINCLAIR-NEWMONT MINING		4,800

TABLE 2. CONTRACTS WITH YPF

	Area	Must spend
Pan American International 15-yr drilling contract and for 40-mile pipeline		No commitment
Carl M. Loeb, Rhoades and Co. (Signal 20%, Union Oil and Gas of Louisiana 16⅔%)		$100,000,000
Petrofina, S. A. 20-yr contract		$ 35,000,000
Union Oil of California 20-yr contract	6,250 sq mi	
Conorada Petroleum 20-yr drilling and exploration		$100,000,000
Royal Dutch/Shell 30-yr contract	11,500 sq mi	$ 25,000,000
Esso Argentina (Jersey Standard)[1] 30-yr contract	2,000 sq mi	$ 23,000,000 (in 6 years)
Tennessee Gas Transmission 25-yr agreement	5,500 sq mi	$ 10,000,000 (in 3 years)

[1]SAPA, Esso's marketing and refining company was ceded to YPF.

ernment, nevertheless, is the company's boss.

The change in method of handling the oil industry was practically forced upon Frondizi because capital was needed and Argentina was spending more than it could afford for oil imports.

Recent announcements of drilling operations is that YPF has a contract with Southeastern Drilling (Dallas) for 1000 wells and with Kerr-McGee for 500 wells. Kerr-McGee is providing 5 rigs and supervisory personnel and will operate two rigs of YPF. ENI has a contract to drill 300 wells. Laughlin-Porter (Midland, Texas) has a contract to drill 40 wells. Astra will drill 30 wells for YPF. Early in 1958, 70 rigs were running and at the end of the year 100 were in the field. Petro Tech Argentina, S.A. (Dresser A.G.) has a 3-year contract covering YPF well completions.

This represents large investment in oil development and in addition Argentina was in December granted $329 million in public and private credits of U. S.

Intensive development of oil resources should cut down soon on the $300 million a year ($270 million in 1957; $206 million in 1956) spent on oil imports. Some of this goes to Russia, which has a contract to supply about 8 million bbl of crude oil in 1958. Argentina exchanged wool for oil.

Total consumption runs about 250,000 b/d.

Reserves are said to have risen to 3.15 billion bbl from 1.1 in 1956.

Natural gas production went to nearly 6 billion cu ft in 1958. When the pipeline from Salta to Buenos Aires is completed output there can be increased.

Construction began on a natural gas pipeline from Bahia Blanca to Mar del Plata, the State Gas Agency announced early this year.

The line, 270 miles long and expected to have a capacity of 1750 Mcf/d will transport gas from the Comodoro Rivadavia Buenos Aires pipeline and eventually will supply other towns on its route.

A crude oil pipeline will connect the San Lorenzo refinery on the Parana River to the north of Rosario, the country's third largest city, with Tacuman 550 miles away. There it will join a line started late in 1956, and which is now half finished, for the remaining 370 miles to Campo Duran. This line of 12¾ in. will initially have a capacity of 57,900 b/d (under three million tons a year).

Alongside this line, for part of the way will run a 24-in. natural gas pipeline, with capacity to deliver 250 million cu ft of gas daily to towns along its line all the way to Buenos Aires, a distance of 1100 miles. This quantity is 4 times more than is being obtained through the pipeline from Comodoro Rivadavia.

These two pipelines are scheduled for completion early in 1960. Orders for 250,000 tons of steel tubing were placed in Austria. The total cost is $182 million. This contract, signed last October, was awarded to TIPSA, an organization acting on behalf of three U. S. firms — North American Utility and Construction Company, Fish Engineering Corporation and Fish Northwest Contractors.

Another pipeline now up for tender would remove the transportation bottleneck at the Neuquen field. A 14-in. line is proposed for the 450 miles to Bahia Blanca. Its initial capacity would be 20,000 b/d, and this could be stepped up to 35,000 b/d by installing additional sub-stations. At the present time production of the Plaza, Huincul and Challaco oilfields is being kept down to 15,000 b/d.

Esso is adding a 47,000-bbl pipe still to its Campana refinery, which now has 37,000 b/d capacity. It will be completed in 1960.

YPF's projected refinery at Bahia Blanca with a throughput capacity of about 38,000 b/d, would process crude oil arriving at Bahia Blanca through the proposed pipeline from Challaco and by ship from the Comodoro Rivadavia area. An addition of 12,000 b/d capacity is being added to the Lujan de Cuyo refinery of YPF.

A new lubricants plant costing about $3.6 million is being built at Avellaneda, near Buenos Aires, for Diadema Argentina S.A. de Petroleo (Royal Dutch/Shell Group).

IPAK, a company formed some years ago by Koppers International and private Argentine interests, proposes to set up near Buenos Aires a $17 million polyethylene plant of some 15 million lb annual capacity. Production is due to start in 1961. It will use refinery gases.

AUSTRALIA

R. C. 211,200 b/d
Runs 196,000 b/d

Search for oil in prosperous Australia goes on diligently despite lack of success in the last 59 years and a cost of $150 million.

There are few places where oil would be so economically useful. Australian vehicles have increased 130 percent in 10 years, one vehicle for every 4 persons, making the country 4th in vehicle density/person. The United States is first, then New Zealand and Canada.

Drilling is going on now in southwest Queensland where Delhi-Taylor is drilling a test near Innaminka to 14,000 ft. This is the first of a 3-well drilling plan.

The concession, 267,000 sq miles, is held by Santos, a local firm, and Delhi-Taylor. Also interested in 110,000 sq miles of the lease are the Frome-Broken Hill group (B-P, Stanvac, Zinc Corporation and Interstate Oil) and American Metal Climax.

A Canadian firm, Humber Oils, Ltd., has acquired a 50 percent interest in the Lucky Strike Drilling Company concession off the coast of Queensland and drilling is scheduled.

Cordillera Mining Company (Dallas, Texas) acquired a 50 percent interest in Australian-American Oil's 20,000-sq-mile concession adjoining the Santos-Delhi area.

Plymouth Oil Company early this year obtained exploration rights over 46,000 sq miles, mostly in Cape York Peninsula, Queensland.

WAPET (Caltex and Ampol) suspended operations in the Exmouth Gulf area where showings of oil occurred in December 1953, but where subsequent drilling has given only negative results. It will now concentrate on the Canning and Fitzroy Basins in the Kimberleys in the northern part of the state, and

will shortly spud in at Samphire Marsh. Shell joined WAPET last year, acquiring 2/7 interest.

Santiago Petroleum, subsidiary of Pan-Israel Oil Company and Israel-Mediterranean Petroleum, has acquired a 75 percent interest in a 5000-mile concession in Queensland. A 25% interest is held by Central Queensland Petroleum Ltd., Australian company.

In 1958, 5 companies obtained shares in the government's million dollar oil search subsidy — Broken Hill, Humber, Santos, Australian Oil and Gas and WAPET. This year the amount of subsidy has been doubled and applications have flooded in.

Stanvac increased capacity of its Altona refinery from 29,200 to 33,000 b/d and runs averaged the same. The company will build two chemical plants near this refinery and two others will be built by chemical firms. The company is constructing a refinery near Adelaide of about 50,000 b/d capacity.

Shell added a catalytic reformer to its Clyde refinery and is building a 11,000 b/d hydrodesulfurizer at Geilong to be completed this year.

Inland and bunker demand in 1958 averaged 186,000 b/d. All crude (196,000 b/d) was imported and some products exported.

AUSTRIA

Prod. 54,310 b/d **R. C. 46,240 b/d**
Gas 79 mcf/d **Runs 38,199 b/d**

Austrian Mineral-Oil Administration (OMV) and Natural Gas Administration (NIOGAS) operate 95% of all oil production, the remaining 5% being privately owned.

In 1958, OMV delivered 19,253 b/d to the USSR reparations account. This was divided among Czechoslovakia, East Germany, Poland, and Hungary.

Reparations were set on basis of estimated reserves, which were much too high. Last year the Soviet agreed to accept a 50% cut — down to 3,750,000 bbl a year to be delivered. Reserves now are estimated at 238 million bbl oil and 883 billion cu ft of gas.

Oil output declined again — about 11% below 1957 but natural gas rose by 8%.

Exploration efforts were intensified. OMV-AG had 7 seismic crews in the field and 17 drilling rigs operating. Of 95 wells drilled, 77 are producers, bringing the total to 910 producing wells. Two tests in Pyrawarth-Helvetia area were successful. In Scheibbs-Amstetler area OMV-AG and British Petroleum are associated with BP the operator. A test (to 6000 ft) is going down at Texing, near Melk. A joint commission from Austria and Czechoslovakia are studying development of Zwerndorf gas field, which extends into Czechoslovakia. It is the largest Austrian gas field.

Agreement was finally reached whereby the 8000 b/d Lobau refinery was returned to Shell and Mobil which have a 50-50 ownership. The Matzen-Lobau pipeline was also returned to Shell-Mobil. OMV still operates the Lobau and 4 other of the largest plants. Shell has one at Floridsdorf and Mobil one at Kagrau. A small privately-owned topping plant is the 9th refinery in the country.

OMV has budgeted $19 million for development and expansion this year. The budget for the new refinery at Schwechat was raised to more than $8 million.

The state-owned Austrian nitrogen works and the Italian Montecatini concern have jointly formed a company to erect and operate a petrochemicals plant adjacent to OMV's Schwechat refinery. Each company holds 40 percent, while 20 percent is to be offered for public subscription. OMV in partnership with the German concern, Farbwerke Hoechst, will also erect a petrochemicals plant adjacent to the Schwechat refinery for production of polyethylene.

Consumption rose 10% over 1957, reaching about 42,667 b/d. This required considerable amount of imports since Austria could keep only about 27,000 b/d of its production. Consequence was a 5¼% tax on oil. The government said the action was taken because of fuel oil imports (mostly from Soviet bloc) at "dumping" prices.

BAHAMAS

Exploration work continues in and around this island. Bahama California Oil Company and Bahamas Gulf Oil Company were drilling at the end of the year at Cay Sal Bank.

Consolidated Cuban Petroleum, a Cuban firm, has a 1500-sq-mile exploration concession in and around Andros Island.

BAHRAIN

Prod. 40,720 b/d **R. C. 186,500 b/d**
Runs 192,000 b/d

Two rigs are kept busy in the Bahrain concession of Caltex and production has been increased a sharp 27% over 1957 when output was 32,031 b/d.

BARBADOS

Barbados Gulf Oil Company and Kerr-McGee have entered an agreement to explore Gulf's concession here. The one well they have drilled in the Scotland district is dry.

BELGIAN CONGO

Exploration is still being carried on by Syndicat d'Etudes Geologiques et Minieres de la Cuvette Centrale. Consumption has risen to about 8000 b/d.

BELGIUM

R. C. 175,000 b/d
Runs 130,000 b/d

The refinery owned by Petrofina and BP has been expanded to a capacity of 90,000 b/d and averaged 80,000 b/d throughput in 1958. A new platformer and a new hydrodesulfurization unit, each having a capacity of 10,000 b/d, were commissioned around the middle of 1958.

Consumption in Belgium is 112,000 b/d, a steep 18% rise from 1957. Because Belgium suffered an economic recession in 1958, this is rather surprising until you realize that competition in selling petroleum products was brisk. This was notably in fuel oil and was intensified by an increase in imports of Russian and Roumanian oil. There is no oil production in Belgium.

BOLIVIA

Prod. 8300 b/d **R. C. 12,500 b/d**
Runs. 5500 b/d

State-owned YPFB, which produces all of Bolivia's oil, had slightly less oil in 1958 than the year before — 4%. Runs at the 4 refineries were 21% off from 1958. This slow down was attributed to YPFB's lack of funds for needed equipment and technical services.

Some concessions held by foreign oil companies are being explored. These were listed in detail in *The Petroleum Engineer**. Since then Atlantic Refining Company has acquired a 1-year option for an 80% interest in Drilling and Exploration Company's large acreage.

There are 17 drilling rigs operating in the country. YPFB drilled 17 new producers bringing total to 95 wells on production and 10 shut in. Gulf, TULM (Tennessee Gas Transmission) and Bolivian Oil (Fish Engineering) are three private companies now drilling.

Three geological crews are operating, one gravity meter crew and one seismic crew.

Reserves are estimated at almost 30 million bbl by YPFB.

Consumption dropped some in 1958. It averaged 5500 b/d. An average of 2500 b/d of crude and 416 b/d of products were exported.

BORNEO (Br.)

Prod. 102,000 b/d **R. C. 50,000 b/d**
Runs 46,000 b/d

Brunei. The "Orient Explorer," first mobile drilling platform built in the U. K., is being towed 9200 miles to

*Interest Quickens in Bolivian Oil Potential, by R. S. Randerson, Jr., *The Petroleum Engineer*, December, 1958, Page E-8.

South China Sea, where Brunei Shell will drill offshore. Four unsuccessful wells have been drilled from fixed overwater platforms. The mobile platform cost nearly $2.6 million, contains 3000 tons of steel, has 4 retractable legs, a helicopter deck, and air-conditioned accommodation for 56 men. It can be used in 100-125 ft of water.

Sarawak. Some offshore drilling has also been done off Sarawak from platforms. These also have been unsuccessful.

North Borneo. Shell of North Borneo abandoned a dry hole off Labuan at 9000 ft. This was also on the Continental Shelf.

BORNEO (Indonesia)

(SEE INDONESIA)

Prod. 14,850 b/d **R. C. 65,000 b/d**
Runs 60,000 b/d

A British tanker was sunk about mid-year off Kalimantan (Indonesian Borneo) in the political upheaval early in 1958. Royal Dutch/Shell, which operates the government's industry in this area, suspended production and closed the Balikpapan refinery.

Shell plans to build a 160-mile/20-in. pipeline from the Tandjung oilfield in Kalimantan to the refinery. Construction will begin in 1959 and will take about 3 years. Cost is estimated at almost $47 million for the pipeline alone. Fields will require another $10 to $15 million to develop in order to raise the production for the line's capacity.

BRAZIL

Prod 51,843 b/d **R. C. 161,000 b/d**
Gas 29,071 mcf/d **Runs 135,098 b/d**

Despite some trouble in Brazil's overall economic set up, the oil industry has accomplished a great deal in 1958. Petrobas, Brazil's national oil enterprise, is devoting more and more of its resources to exploration. Thirteen geological crews and 26 geophysical crews were operating during the year. There were 53 active drilling rigs that drilled a total of 139 wells; 81 were producers. The country now has 212 wells producing oil and gas. Production during the year was 21% above last year for oil, and 35% for natural gas.

Much of the effort of Petrobras is in the Amazon basin, one of the largest sedimentary areas in the world and one of the most difficult to explore.

Reserves are estimated now at 480 million bbl of oil, 482 billion cu ft of gas.

Brazil's 8 refineries were expanded 19% in 1958 and runs increased 11% over 1957. Petrobras Rio de Janeiro refinery, now under construction, will have a capacity of 90,000 b/d. Crude capacity of the company's Mataripe refinery in Bahia state is being expanded to 42,000 b/d from 5000 b/d.

Consumption rose 8% in 1958 and averaged 215,602 b/d. This means that imports of crude oil were 114,883 b/d and products 86,873 b/d. On the other hand Brazil exports 22,600 b/d of crude oil. Some of the Bahia crude is purchased by Esso Export for its Aruba refinery. It has a heavy wax base. The transaction calls for Brazil to purchase Venezuelan crude from Creole for its own refineries.

At the end of the year Brazil's Congress was investigating the petroleum policy in joint development of the Bolivian-Brazil area. Some objected to foreign financing of private Brazilian companies in Bolivia, and demanded that the Brazilian government assist in financing by making available foreign exchange for importing equipment.

BRITISH GUIANA

In this territory on the north coast of South America a Standard of California subsidiary holds the only exploration concession, which is 16,000 sq miles. In 1958 one marine seismic crew worked for a month about mid-year in the submerged lands off the west coast.

BULGARIA

Prod. 5700 b/d? **R. C. 2000 b/d?**
Runs 1500 b/d?

Construction of the largest refinery here — 20,000 b/d — is to begin during Five Year Plan, 1958-1962. Russian crude will be used. Meanwhile expansion of existing refineries is expected to boost capacity to 2400 b/d in 1960. Refineries are at Sofia and Ruse. Bulgaria's products imports are around 10,000 b/d from Russia alone, which meets most of the 14,000 b/d consumption. Its crude exports are around 3000 b/d. Crude production is in the Dobruja.

BURMA

Prod. 8200 b/d **R. C. 8500 b/d**
Runs 7800 b/d

Developments in 1958 proceeded at a fast pace in the Chauk-Lanywa oilfields, where crude oil production was 434,075 bbl above the 1957 total. Twenty-three wells were drilled in the fields during the year as against 16 in 1957, while 29 wells were unplugged to become producers again and 3 were reconditioned as against 12 and 2 respectively in the previous year.

Reflection seismic work was resumed by the company at the end of the year in the delta of the Irrawaddy River.

Outside tests drilled in 1958 included two wells at Ondwe, south of the Chauk field, and a deep well (12,000 ft) at Kyaiklat, near Hteingyun Village in the Irrawaddy delta south of Rangoon. None of these tests was successful, and drilling is now in progress at Dedaye, also in the delta, while steps are being taken to test a structure 20 miles east of Yenangyaung.

Drilling contractors for Burma Oil Company (1954) Ltd., (Burmah Oil, Indo-Burma Petroleum and British Burmah Petroleum and their Government partner) are the Sante Fe Drilling Company of California.

The refinery at Chauk in the central Burma oilfields area was onstream throughout the year, throughput being cut back at the end of the year to enable crude to be stockpiled at the Syriam refinery (near Rangoon) as a safety measure against possible dislocation of the crude oil lift by river during the low-water season of 1959. Stocks of crude from the oilfields to Syrian refinery continue to be moved by the Government-owned Inland Water Transport Board with oil barge trains and pusher tugs.

Syriam's 1958 throughput was an increase of some 40% over the previous year's total, and with this increased production Burma is now self-sufficient in major petroleum product requirements other than aviation fuel and furnace oil for international bunkering. Considerable attention was paid by the company in 1958 to improving the operation of the refinery in accordance with the trends of modern practice.

Sales of all major petroleum products were 10% above 1957, motor spirit sales alone increasing by 6.7%. Due to the restoration of communications with villages which had hitherto been under insurgent domination sales of kerosine increased by 5.9% in 1958. Industrial growth and continuing expansion in the activities of the Electricity Supply Board, the Inland Water Transport Board and the Burma Railways increased fuel oil sales by 13.3% over the 1957 total.

CAMEROONS (French)

This small area in the angle of the West African Coast, is being explored by SEREPCA, owned principally by the French government. The territory is a French trusteeship. It extends into Nigeria, but is mostly in French Equatorial Africa.

Consumption runs about 1800 b/d.

CANADA

Prod. 453,514 b/d **R. C. 851,750 b/d**
Gas 1,098,599 mcf/d **Runs 658,738 bd**

Because of its vast industry, we cannot possibly in this space give anything except bare statistics on the Canadian operations for 1958. We urge you to refer to H. G. Cochrane's annual report on Canada.*

Perhaps the most important recent happenings as far as the Canadian oil industry is concerned, was President

Eisenhower's taking Canada and Mexico off the restriction list for imports. The Canadian industry had appealed to their own government for some relief, but things were looking up at the end of the year when 194 drilling rigs were operating. In 1958, 2516 wells were drilled, of which 1640 were producers, 793 were dry holes and 83 were service wells.

A monthly average of geological crews operating was 15 and geophysical crews averaged 90 in the field in 1958. Production fell off in Canada as it did in the United States. It was 9% lower than in 1957. The first time since we began our survey when Canadian production fell from one year to the next.

At the present time oil reserves are estimated at 3.2 billion bbl of oil and 23.3 trillion cu ft of gas.

Although refining capacity increased about 11%, runs were approximately the same as they were in 1957. Canada now has 45 refineries and 2 new ones are being built. These are BP Canada Ltd. at Ville d'Anjou, Quebec, 25,000 b/d capacity; and Irving Refinery Company at E. St. John, N. B., 38,000 b/d capacity.

The following expansion programs are being carried out: British American, Clarkson, Ontario, adding fluid catalytic cracker 6000 b/d; Canadian Oil Companies, Corunna, Ontario, expanding crude unit from 30,000 to 50,000 b/d; vacuum unit from 15,000 to 25,000 b/d.

Most important pipeline project, which is scheduled to be constructed over the next two years, is the Alberta Gas Trunkline, Ltd., of Calgary. It is a natural gas line to run from Dick Lake area 337 miles south to the company's main junction to supply Trans-Canada with additional gas.

CEYLON

There are no known deposits yet established of crude petroleum in Ceylon. Ceylon's annual consumption of refined petroleum products is estimated at 20,000 b/d, 50 percent bunker oil.

Proposals have been made by certain foreign groups to establish at their expense a complete refinery operating on crude oil to meet the full requirements of the country for the next 10 years. The negotiations are still pending with the Government of Ceylon.

CHILE

Prod. 17,000 b/d **R. C. 20,700 b/d**
Runs 20,000 b/d

Sr. Oscar Schneider, exploration manager of ENAP, the national oil company in Chile, visited in The Petroleum Engineer offices and gave us some background of the Chilean oil industry.

*"Canada Has Mixed Year," *The Petroleum Engineer*, Page A-28, March, 1959.

So far ENAP is the only one with the authority to develop oil in Chile. There have been several proposals for liberalizing the petroleum law but nothing has been approved.

ENAP has the only production, on the island of Tierra del Fuego. It drilled 74 wells (38 producers) with its 5 rigs in 1958.

There has been considerable exploration in other parts of the country and at present there are 2 geological crews in the north and 1 in the south. Two geophysical crews are working. ENAP seems to feel that its exploration work has gone so far it should be given an opportunity to develop potential areas.

As most political entities, the company is held down by lack of capital. So far investments have been about $85 million in the Magellan field and $64 million in the Con Con refinery, the only operating refinery in the country. Since 1954 all operation costs have been covered by sale of products.

A crude oil pipeline is being built from the producing area across the Strait of Magellan to the mainland; about 3 miles of the line is under water. Another pipeline recently completed is the products line from the Con Con refinery to Santiago. This was built by ENAP and Esso, each 26%, and a local concern, COPEC, 48%. It is about 75 miles long.

The Con Con refinery is being expanded from its present capacity to 45,000 b/d. New units include a 12,000 b/d catalytic cracker, a 6000 b/d catalytic reformer, and a 1100 b/d alkylation unit.

Consumption at present runs about 38,000 b/d, a 7% increase. There is a small gasoline plant at Manantiales, near the production area on Tierra del Fuego.

CHINA (Communist)

Prod. 18,000 b/d? **R. C. 42,000 b/d?**
Runs 40,000 b/d?

The Five Year Plan lays great stress on oil development and recent discoveries are promising. At present at least half the production comes from Yumen field in Kansu province, discovered in 1939. In 1958 discoveries were made in Central Szechwan, where natural gas has been produced for years; in the Dzungaria area of Sinkiang (the Karamai field), and the Tsaibam area of Tsinghai province.

The production figure we get from Red China's releases is 45,000 b/d, but this includes oil shale and oil from coal.

China's first crude oil pipeline, almost 100 miles long, is being built to connect the Karamai field with a refinery at Tushantze, both in Sinkiang. This was reported to be completed in January. The refinery was expanded to handle 8000 b/d crude.

Red China's production went up about 50% in 1958 over 1957 and is predicted to rise another 50% this year. Red Chinese government estimate of reserves is 14½ billion bbl. Information released hardly accounts for this amount of reserves.

A new 6000 b/d refinery at Nanchung (about 100 miles northwest of Chungking) will go onstream in 1959. It will process crude from nearby, newly developed Szechwan Basin oilfields. The Lanchow refinery is in operation at less than capacity and construction is still going on at the plant.

Considering China's 600 million people, it probably has the lowest per capita consumption of any nation in the world. Besides its own production, it imports from the USSR about 36,036 b/d, mostly in products. Long distance pipelines are being built from Siberia to China to facilitate the flow of oil. Oil also comes from Romania and Sakalin.

Total consumption does not amount to more than 80,000 b/d and this is supplied not only by crude oil but by synthetic oils. One report said that China's imports of petroleum products from the USSR more than doubled last year.

COLOMBIA

Prod. 128,000 b/d **R. C. 73,900 b/d**
Runs 64,500 b/d

News stirring the industry in Colombia is the new proposed legislation amending the oil code. The whole idea of the new bill is to push exploration. It would cut the exploration period one year and would have those who sign concessions surrender 50% in the first year of exploration. There are other terms which would change the depletion allowance and the income tax. These appear to be fundamental changes. A statement recently made by Dr. Jorge Ospina Delgado, former minister of mines and petroleum, states that the country was not able to exploit its own petroleum reservoirs and advised some changes so that investments would be stimulated in order to take advantage of the immense potential of riches that remained unexploited.

Colombia gets its oil from fields that are roughly along the Magdalena River in a valley between 2 Cordilleras of the Andes. There are 5 private oil producing companies and Ecopetrol, the state entity. Non-producing operators total 8, as shown in Table 3.

Ecopetrol was formed to take over the De Mares concession of International, whose lease had terminated. Largest producers are Shell Condor, S. A., The Texas Company, and Colombian Petroleum (Socony-Texas). International Petroleum (Jersey Standard) is a very small producer. Most of

TABLE 3. Colombia Oil Producers

Empresa Colombiana de Petróleos	ECOPETROL
Texas Petroleum Company	TEXAS
Colombian Petroleum Co. (Mobil-Texas)	COLPET
Shell-Condor S. A.	SHELL
International Petroleum Co. (Colombia) Ltd.	INTERCOL
Compañí Petrolera Nueva Granada	NUEVA GRANADA
Non-Producing Operators	
Richmond Petroleum Co. (Socal)	RICHMOND
John W. Mecom	MECOM
Mobile Oil Co. de Colombia	MOBIL
Amkirk Petroleo Corp.	AMKIRK
Colombian Cities Service Petroleum Co.	COLCITCO
Colombian Sun Oil Company	SUN
Forest Colombian Corp.	FOREST
Intercontinental Petroleum Co.	INTERCONTINENTAL

its investment is in refining and marketing.

In 1958, 167 wells were drilled. This is 7 more than in 1957, including 32 wildcats and 11 stratigraphic tests. Ten wildcat rigs are working in areas in the Magdalena valley and in the Llanos, and 15 field rigs plus 21 service units total 46 rigs in Colombia.

There are 2 integrated refineries and 3 topping plants in Colombia. A new refinery was completed at Cartagena last year by International. Ecopetrol has the largest refinery at Barrancabermeja. It is now running at an average of 33,000 b/d. IPC also has a topping plant at La Dorada. Colombian Petroleum Company has one at Tibu, and The Texas Company operates a topping plant at Guamo. Refining construction is not under any government control or license, but ceiling prices set at service stations are badly squeezing the refiner.

Consumption is almost exactly what it was in 1957 (48,000 b/d) because of the recession and the monetary troubles of the government. The peso was devaluated in 1958 from 6 pesos/dollar to 8 pesos/dollar. Its value is still weak. Official exchange rate is 6.10 pesos to $1, but the free market rate is about 8.05 pesos for $1. This devaluation took place over a 12-month period.

Oil exports are obviously a big help to Colombia's fiscal budget. Needs of the budget, however, are a problem for Ecopetrol, which finds its profits taken over by a needy government instead of using them for development of the company. In 1958, about 22% of its gross income (or $1.20/bbl of oil produced) was turned over to the treasury. This, of course, shows up the weakness of a political entity. The new bill suggests that private interests might be allowed to buy into Ecopetrol, which might be a saving factor so far as the company is concerned.

COSTA RICA

Compania Petrolera de Costa Rica, Ltda. (Union Oil of California) has only concession here. It has drilled 8 wells. One well produced heavily on test but operator was unable to shut off the water. All wells have been abandoned. Another well is scheduld to be drilled in 1959.

CUBA

Prod. 941 b/d **R. C. 88,400 b/d**
Runs 73,117 b/d

Oil operations dragged to a stop during political upheaval; nevertheless, considerable work was done in 1958. Eight geological and 3 geophysical crews were in the field.

The 10 rotary and 20 cable rigs drilled 58 wells, of which 14 were producers. This makes 125 to 150 wells producing in the Motembo field, 38 in others and 7 shut in. Reserves are estimated at 3 million bbl.

The refining situation in Cuba has shown tremendous growth in the past few years.

In 1954 the Esso Belot refinery had a capacity of 9700 b/d; the Refineria Cabiaguan 1000 b/d and the Bacuranao topping plant 300 b/d.

In 1955 the Cabaiguan refinery was expanded to 2000 b/d.

In 1956 Shell began building a 28,500 b/d plant, Refineria Habana, on Havana bay; Texaco began work on a 20,000 b/d plant on Santiago de Cuba bay; Esso began reconstruction and enlargement of its Belot refinery on Havana bay to 35,000 b/d. The Cabaiguan refinery enlarged its plant to handle 2500 b/d. Cuba's refining capacity was 40,100 b/d on January 1, 1957, when the Shell refinery was put onstream.

The Refineria de Petroleo Santa Maria, S. A. was constructed in a suburb of Havana during 1958 and went onstream in August 1958. It is a topping plant with a capacity of 600 b/d and may later be enlarged to 1000 b/d.

On January 1, 1958, capacity was 59,200 b/d; it was 86,200 b/d on July 1, 1958, and 88,400 b/d by December 31, 1958.

Consumption averaged 64,500 b/d in 1958. Future trends depend on Castro's economic program.

CYPRUS

Forest Oil Corporation of Bradford, Pennsylvania, has renewed its exploration license for another year. No wells have been drilled under this license so far.

CZECHOSLOVAKIA

Prod. 2800 b/d **R. C. 26,000 b/d**
Runs 20,000 b/d

Production of oil has eased off, according to reports but gas output is up (see Austria). Imports from USSR are rated at 24,000 b/d crude and products. Consumption is about 30,000 b/d, around 8000 b/d coming from lignite.

A refinery near Bratislava went into operation in 1958. A chemical plant at Brüx is being constructed to supply synthetic rubber.

Reports are pretty vague from this Communist country.

DENMARK

R. C. 4250 b/d
Runs 3541 b/d

One rig is operating in Denmark for the Danish-American Prospecting Company (Jersey Standard). Of the 9 wells drilled all have been dry. One geophysical crew is operating.

There are 2 small refineries in Denmark, 1 at Copenhagen and 1 at Kalundborg. These processed an average of 541 b/d in 1958. The Maersk refinery near Copenhagen went onstream in 1958. It has a capacity of 3500 b/d and estimate is that it is running around 3000 b/d at the present time.

Denmark's consumption is 85,000 b/d. It rose 12% in 1958 over 1957, supplied principally by imported products.

DOMINICAN REPUBLIC

We know of no concessions granted here, although a new law was executed in August 1956, which allows contracts between the Executive Power and private industry. The law states:

"Only Dominicans and Dominican concerns shall be granted the right to explore, exploit, and profit from the resources to which this law refers. The same rights will be granted to foreigners, either physical or legal persons, when in the particular contract they agree to respect exclusively in all that refers to the rights obtained, the jurisdiction of the courts and the legislation of the Dominican Republic."

ECUADOR

Prod. 8925 b/d **R. C. 6300 b/d**
Runs 6410 b/d

Two companies have production in Ecuador — Manabi Exploration and Anglo-Ecuadorian Oilfields and 2 others have exploration licenses.

Ecuador's entire petroleum production is derived from the western portion of the Santa Elena Peninsula in southwest Guayas Province.

As a result of the Ecuadorian Government's failure to increase the fixed prices of gasoline and of other locally refined products, Anglo-Ecuadorian in March 1958, indefinitely suspended the construction of its new refinery at Puerto Rico (La Libertad), which was originally scheduled for completion later this year. In addition the company drastically reduced drilling activities and is eliminating all possible capital expenditures until the situation improves.

Manabi operated only 3 drilling rigs — 1 for shallow development drilling and 2 for 5000-7000-ft development wells in 1958. Manabi suspended its drilling activities last year due to labor difficulties.

California-Ecuador Petroleum Company (Standard of California) drilled its first test well, Santo Domingo No. 1, to 10,085 ft and it was subsequently abandoned, encountering, below 2000 ft, "shale gas" in fairly large quantities. CALEC's offshore seismic survey, conducted in the Gulf of Guayaquil, where it has extensive concessions, was completed late in 1957.

Tennessee Gas Transmission has acquired a concession in the Daule Basin, 20 miles north of Guayaquil.

EGYPT

Prod. 60,000 b/d **R. C. 90,000 b/d**
Runs 76,000 b/d

Unification of Egypt and Syria extends to the oil industry. A public corporation has been set up to deal with the oil affairs of all companies. It is reported that Royal Dutch/Shell will return to Egypt; its interests were seized at the time of the Suez crisis. The Egyptian state also took over all British properties at that time and negotiations are proceeding for their return. Shell and British Petroleum have joint operations in Egypt. Mobil is also interested in Egypt, on the Sinai Peninsula.

General Petroleum Authority, the state entity, has 2 new fields on the Red Sea coast.

The Egyptian government has recently agreed with Mannesman, a German firm, to build three products pipelines to run from Alexandria to Tantah, from Agroud to Cairo and from Alexandria to Kafr el Dawar. This will cut down on cost of distribution.

Four independent U. S. oil companies have given up a vast prospecting operation in the Western Desert of Egypt after spending about $30,000,000 in 4½ years. The exploration was carried out by the Sahara Petroleum Company, an operating subsidiary of the Continental Oil Company. Sahara Petroleum's operation was backed by the Ohio, Richfield and Cities Service oil companies in conjunction with Continental. The concession covering 90,000 sq miles was signed by the Egyptian Government and the U. S. oil interests in February 1954. One well went to a total depth of almost 15,000 ft. A second one was 14,643.

The United Arab Republic granted an Italian-Egyptian oil company (called Eastern Oil) new concessions for oil prospecting for 13 years in Egypt's Sinai Desert, including offshore areas in the Red Sea.

Consumption runs around 85,000 b/d.

FINLAND

R. C. 23,250 b/d
Runs 17,625 b/d

The year 1958 was the first whole year the new Finnish refinery was on-stream. The Neste Oy's refinery at Naantali, near Turku, commenced limited operations on August 23 with the production of fuel oil and diesel oil.

In 1958 average consumption was 32,548 b/d. Imports of products were more than 16,000 b/d and crude oil for the refinery was imported.

FORMOSA

Prod. 41 b/d **R. C. 24,700 b/d**
Gas 40 mcf/d **Runs 16,725 b/d**

In 1958 6 drilling rigs were operating and 8 wells were drilled. Three of these were producers. Four geological crews and 2 geophysical crews have been in the field during the year.

Refining capacity is enough to take care of the 16,725 b/d consumption. Enough crude is imported to handle the necessary runs. At the Kaohsiung refinery 2 new units are being constructed — a 900 b/d alkylation unit and a 10-ton/d sulfur recovery unit. This is the only refinery in the country. The Chinese Petroleum Corporation operates all the oil industry in Formosa or Taiwan.

FRANCE

Prod. 27,640 b/d **R. C. 713,200 b/d**
Gas 65 m²cf/d **Runs 550,000 b/d**

Oil production did not increase in France proper in 1958. Exploration, however, met with success. Much of this is due to the government's determination to develop oil and gas resources and its use of much needed capital to make some progress. The French petroleum industry has learned one fact — that it requires capital to develop resources. Thirty-four new oil wells were drilled in metropolitan France and 23 new gas wells. Much of this work was done by French companies in which the state had an interest. The French government has a controlling interest in 15 companies and some interest in 26 others.

TABLE 4. Some French Companies and Their Abbreviations

RAP	Regie Autonome des Petroles
SPG	Societe des Petroles de la Garonne
SNPA	Societe Nationale des Petroles d'Aquitaine
CEP	Compagnie d'Exploration Petroliere
PREPA	Societe de Prospections et Exploitations Petrolieres en Alsace
FROPEX	France-Outremer de Prospections et Exploitations Petrolieres
CPG	Compagnie des Petroles de Guyenne
ESSO-REP	Societe Esso de Recherches et d'Exploitations Petrolieres
CFPN	Compagnie Francaise des Petroles (Normandie)
CFPG	Compagnie Francaise des Petroles (Gascogne)
SPV	Societe des Petroles de Valence
PETROREP	Societe Petroliere de Recherches dans la Region Parisienne
SAFREP	Societe Anonyme Francaise de Recherches et d'Exploitations Petrolieres

CEP discovered oil in a wildcat 6 miles west of the 2 producing wells at Chailly.

Refining capacity is being expanded throughout France. At Shell's Petit Couronne refinery an increase of 39,000 b/d was added by new distilling units in 1958. Shell is now scheduling an 11,000 b/d hydrodesulfurizer and a 13,000 b/d catalytic reformer. A new distillation unit was commissioned at BP's Lavera refinery, raising capacity to 80,000 b/d.

Five leading French chemical concerns have combined to form a new company, to be known as Acetalacq, for the exploitation of chemical by-products from Lacq gas.

The Societe du Caoutchou Butyl (SOCABU) received last month from the refineries of Compagnie Francaise de Raffinage and of Esso Standard the first supplies of butane feedstock for its recently completed factory for making synthetic butyl rubber, a material used for inner tubes of tires and other industrial purposes.

The French Government has set up a Service de Conservation des Gisements d'Hydrocarbures which will be responsible for oil and gas conservation. The authority will be responsible for collecting and distributing samplings, documents and data on oil and gas exploration and for coordinating the supervision of production. It may undertake studies on behalf of commercial operators, charging a fee for its services.

Consumption in France amounted to 384,500 b/d in 1958. This is inland consumption only and it increased from 1957 by 14%. Prices were raised from 92 francs a litre in May 1958 to 98 francs (1 franc = 14½¢) a litre (3.78 liters = 1 U. S. gallon) in February 1959. This additional taxation for French gasoline is used by the government to put into capital expenditures and exploration.

France made a new 3-year trade agreement with Russia in which oil imports would be dropped from year to year. Russia is now shipping a little more than 20,000 b/d of crude oil and products to France.

FR. EQUATORIAL AFRICA

(GABON)

Prod. 9000 b/d

Output of the fields in the Gabon Basin more than doubled in the last year. Eighteen drilling rigs are operating in the area for Ste des Petroles d'Afrique Equatoriale Francaise (SPAEF), a French-government company. Four fields have been discovered in the territory of Gabon and more recently oil was found near Pointe Noire in the Middle Congo region.

Recently Royal Dutch/Shell group and Mobil entered an agreement with SPAEF for equal partnership in Gabon. The joint venture will cover an area of 1500 sq miles.

FRENCH WEST AFRICA

This west coast territory includes Senegal, French Guiana, and Ivory Coast.

One exploratory well is being drilled by Societe Africaine des Petroles and Plymouth Oil. The joint permit covers 3700 sq miles. The site on the Ivory Coast, was chosen after 2 years geological and geophysical work. SAP has another concession besides the one it is working with Plymouth.

Besides these companies, Societe des Petroles du Senegal (SPS), a French government and British Petroleum combine, is drilling in South Senegal.

All of French West Africa uses about 12,000 b/d oil products.

GAMBIA (Br.)

British Petroleum and Bureau de Recherches de Petrole (BRP), which has a 50-50 interest in a Gambia license, worked throughout 1958 on a seismic survey.

GERMANY (East)

Prod. 600 b/d **R. C. 35,000 b/d**
Runs 30,000 b/d

According to reports East Germany has found some small reserves of crude oil in the Harz Mountains and in Mecklenburg. This has increased production from about 60 b/d to 600 b/d.

A plan is developing for an Eastern European crude oil pipeline to run from the Volga-Ural to the Frankfurt-on-Oder area in East Germany. This is a distance of some 2500 miles. It would have an initial capacity of close to 100,000 b/d and would supply the refineries and petroleum chemical plants in East Germany.

At present these refineries process about 30,000 b/d, part of which is exported. The plants were designed originally to treat coal and lignite, but recently have been running on crude oil from the USSR. New plants are scheduled for the 1956-1960 Five Year Plan.

From various figures, it appears that East Germany's consumption is around 45,000 b/d.

GERMANY (West)

Prod. 86,000 b/d **R. C. 570,000 b/d**
Gas 33,000 mcf/d **Runs 310,000 b/d**

The strong advance of West Germany's petroleum industry is an indication of its economic progress. There were five more geophysical crews in the field than last year, making 75 in 1958. A total of 103 rotary rigs were working (170 in 1957) and 534 wells were drilled, of which 351 were producers. This brings total wells producing to 3400. Production advanced 12%.

Reserves were increased and are estimated now at 490 million bbl of oil and 200 billion cu ft of gas.

Refining capacity went up a sharp 43% and runs advanced 35%. Now under construction are: 90,000 b/d capacity plant at Dinslaken, owned by BP Benzin und Petroleum AG; 85,000 b/d plant at Godorf, near Cologne, owned by Deutsche Shell AG, and 20,000 b/d plant at Duisburg-Neuenkamp, owned by Purfina Mineraloelraffinerie AG.

At the present time the 186-mile, 24-in. Rotterdam-Godorf crude oil pipeline is under construction and is expected to be completed about the middle of 1960. It will have a capacity of 150,000 b/d. The line belongs to Rotterdam-Rijn Pijpleiding Mij. (BPM — Royal Dutch/Shell — 40%, Caltex 20%, Gelsenberg & Mobil Oil A.G. 40%. The 215-mile, 28-in. crude oil line from Wilhelmshaven to refineries near Cologne was completed in 1958 by Nord-West Oelleitungs GmbH (Esso AG 47.2%, B.P. 26.3% others 26.5%.

West German consumption increased by 14% over 1957 and averaged 365,000 b/d. This was provided for with 216,000 b/d crude oil imports and 108,000 products imports; 23,500 b/d of products were exported but no crude oil.

New trade agreements with the Soviet Union will double the quantity of imports in 1959 and treble it in 1960. For 1958 imports are: 10,000 b/d of crude oil and almost the same of products.

GHANA

Gulf Oil Company of Ghana has the only exploration permit. There was no activity in 1958 except a few days of marine seismic work tying Gulf's Ghana survey into SAP-Plymouth's Ivory Coast work.

GREECE

R. C. 36,000 b/d*
Runs 35,000 b/d*

One wildcat was drilled during 1958, the Tavri Southwest No. 4, in Thrace. All 4 wells drilled in this area were non-productive. Exploration is being carried out by a Greco-West German group.

The new 36,000 b/d refinery at Aspropyrgos near Athens, was officially opened November 5 and is now running near capacity. A 10-year agreement was made with a new locally formed company, Oil Transport, Trading and Refining Company, to lease the plant. Two main shareholders are a Greek industrialist and a Greek shipowner, with Socony Mobil and Hydrocarbon Mineraloi having minority holdings. Socony Mobil provides the crude. General director of the Greek oil refinery gave as an estimate of consumption at this time as 36,000 b/d. This is a 28% increase over last year.

A trade agreement provides that Greece will obtain from the Soviet 7500 b/d products, mainly fuel oil, in 1958 and 10,000 b/d in 1959 and 1960. Since the opening of the new refinery this has been changed to crude oil and only 3500 b/d of products are being imported.

Construction of a new oil refinery at Piraeus, near Athens, is planned by the Greek firm, Elbyn Lubricating Oil Refinery, Ltd. Capacity would be 6000 b/d. Construction is estimated at $3½ million, with 18 months required for construction.

GUATEMALA

Petroleum exploration work has been speeded up recently since the government's decision to retain the status quo of surface leasing. Exploration rights granted or bid for total 53 and area rights reach 11 million acres. U. S. companies have so far spent some $20 million in Guatemala in 1958 alone simply to get concessions and prepare for drilling.

Sun Oil has 1 gravity meter crew and 1 geological crew doing exploration. Coastal Plains Oil and Gas Company (formerly Sloane Exploration) drilled

*Not 1958 average.

a test in Izabel Province, which was suspended at 4498 ft. Standard of California spudded in its first well near Livingston north of the Rio Dulce. Ohio Oil Company of Guatemala (Ohio, Amerada, Conoco, Union of California) spudded in its first test in the Department of Alta Verapaz. Other wildcats are planned for 1959. Atlantic Refining has begun a well east of La Libertad.

A project for constructing the first refinery, submitted by a United States firm, Breaux Bridge Oil Refining Company, Inc., has been approved by the Guatemalan Government. The 2800 b/d refinery will be at Puerto Barrios on the Caribbean Coast, 185 miles northeast of Guatemala City. Construction is due to begin early next year, and the Shell group will assist in financing the project. Products will be taken by Cia. Distribuidors Guatemalteca Shell, in which the Royal/Shell group and Canadian Eagle each have a 50% interest.

We estimated Guatemalan consumption last year at 7500 b/d but it was 6800 and is probably running around 7000 b/d at present.

HAITI

Commonwealth Oil Company, Houston, Texas, owns the only concession in Haiti. Consumption runs about 1000 b/d and all of it is imported as petroleum products.

HAWAIIAN ISLANDS

R. C. 3000 b/d
Runs 2800 b/d

The 50th state of the United States will have its second refinery completed about the end of 1960. Standard of California began construction in October on the 32,000 b/d plant near Honolulu. It took 4 years of negotiating to obtain permission to construct the refinery. At present there is only one at Oahu, an old plant of Pacific Refiners, Ltd., of 3000 b/d capacity.

Crude supplies for the new Hawaiian refinery of Standard of California will probably come from Sumatra, the Middle East, and Venezuela. Products will include gasoline, jet fuels, diesel oil, stove and furnace oils, fuel oil, LPG and asphalt.

HONDURAS

A new petroleum law passed in 1957 follows the more enlightened codes which attract foreign capital.

Two companies have concessions in Honduras. One is Petroleos Hondurenos S. A., made up of a group of independents and local interests. This company drilled two wells in 1958, both dry, and has two geological crews in the field. The other concern, Compania Petrolera Hondurena, has a concession in North Honduras.

A refinery is planned. At present 50,000 b/d products are shipped in to supply demand.

HONDURAS (Br.)

Five wells were drilled in British Honduras in 1958, all of which were dry. These were drilled by Gulf and Shell, who are exploring the country together and have a 2-rig wildcat program.

Concessions covering approximately 5600 sq miles of Crown land north of the Maya Mountains in British Honduras are offered to U. S. investors for oil prospecting under the terms of the Oil Mining Regulations of the Government. Write to Secretary of Natural Resources, Belize, British Honduras, for information.

HUNGARY

Prod. 15,000 b/d? **R. C. 37,000 b/d?**
Runs 35,000 b/d?

Output in Hungary rose slightly in 1958 and new reserves were reported in the great Hungarian Plains, which run across the country from near the Czechoslovakia frontier to the Yugoslavia frontier. The entire increase was due to production from these new fields.

Hungary's refining capacity, which is in and near Budapest in the Zala area, is estimated at nearly 40,000 b/d and runs are approximately 35,000 b/d. This amount does not meet the requirements and imports come from Russia.

A gas line from the Romanian Transylvanian field to Tisza Valley of northeastern Hungary was completed in December 1958.

INDIA

Prod. 9500 b/d **R. C. 104,500 b/d**
Runs 100,000 b/d

In 1958 a parliamentary estimates committee reminded the Indian Government of inordinance delays in reaching agreements for development of India's oil. It suggested that the Oil and Natural Gas Commission seek cooperation of private enterprises. No licenses have been given to private concerns for 3½ years.

The Oil and Gas Commission is now exploring in 4 areas. It found gas at 2700 ft in northern Punjab and drilling is going on here and in Cambay, in eastern India, and in Assam. Russian and Romanian technicians are carrying out all 4 tests. The 4 rigs were purchased from Eastern Europe at a cost of $3 million.

Only other exploration is being carried out by Indo Stanvac, in which the Indian Government has a 25% interest in West Bengal. Three wells were drilled here and all 3 were dry. Geophysical crews did 18 party months work during the year.

Assam Oil Company (Burmah Oil and Indian Government) is developing its reserves at Nahorkatiya, which has about 25 producing oil wells and 2 gas wells. The same company is developing Moran reserves where 12 wells have been drilled. These fields are shut in awaiting pipeline and refining outlets. This is one reason for the lack of progress in production in 1958.

India's only oil production continues to be from the Assam Oil Company field at Digboi.

There are 4 refineries in India. One is the Assam 8900 b/d plant at Digboi. Shell and Stanvac each have refineries at Bombay, and Caltex has one at Vishaktman. Negotiations have begun with the Romanian Government for that country to build an oil refinery in Gauhati in Assam State. It would have a capacity of 15,000 b/d.

At present India consumes about 115,000 b/d, inland and 8300 b/d bunker, 93% of which must be imported. In 1957 crude oil imports cost more than $200 million, all of which had to be paid in foreign exchange.

About mid-year the three private companies operating refineries volunteered to reduce oil prices by 10% as the result of negotiations with the government. The government is said to be considering entering the oil distribution trade. Rising consumption in 1958 is estimated at 6% more than in 1957.

INDONESIA

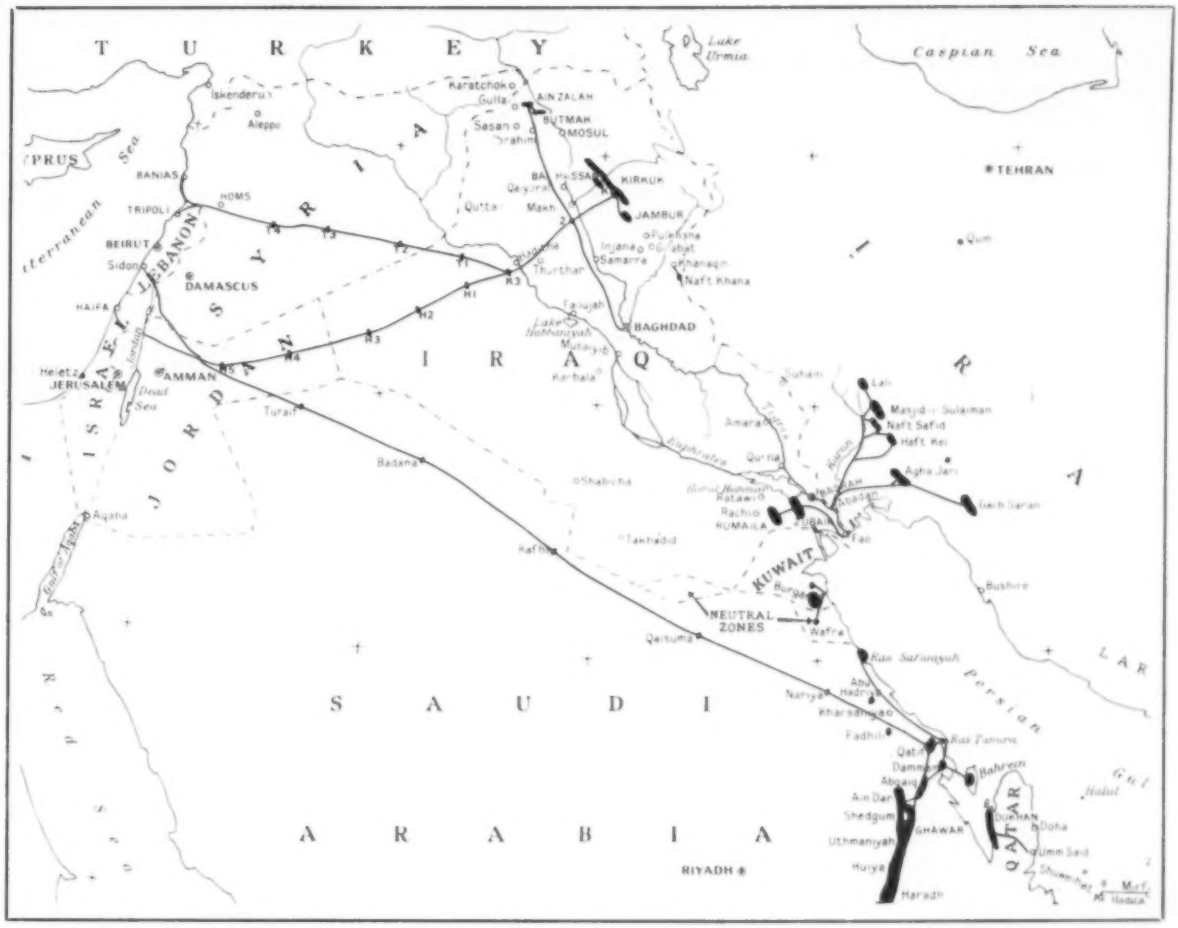
Prod. 336,000 b/d **R. C. 247,800 b/d**
Gas 76 mcf/d **Runs 232,600 b/d**

Despite the civil war and economic hazards, as well as a flood of government decrees, the oil industry persisted in Indonesia and pushed ahead in the vast development program. So far U. S. oil companies alone have invested some $250 to $300 million in oil facilities and development in Indonesia.

Caltex is developing a new field at Duri, Sumatra. Work was interrupted during the war but is back close to normal now. The great Minas field of Caltex now produces around 192,000 b/d. It averaged 162,000 b/d in 1958.

Stanvac's oil production reached 75,157 b/d from its old fields and the new Lirik area. Stanvac drilled 24 wells — one a wildcat — found a new field and added 20 producers. It has about 254 wells producing. Two drilling rigs are in operation.

In 1958 consumption was about 78,200 b/d, including bunker fuel. This was lower than in 1957, and was probably due to the civil war. Estimates on exports are 147,000 b/d



THE MIDDLE EAST SCENE: Syria in the United Arab Republic is crossed by pipelines from Iraq, under a revolutionary government.

crude and 141,000 b/d products. Imports run 40,000 b/d crude and 8000 b/d products.

The Indonesian government has submitted a new oil bill to parliament. It provides for exploration by government as well as by joint government and private enterprises, in which the government would have a major holding and also by private concerns.

IRAN

Prod. 821,000 b/d **R. C. 412,000 b/d**
Runs 310,000 b/d

Pan American Oil Company expects to start drilling in 1959 on its new concession offshore the Persian Gulf. The company is an equal partnership of National Iranian Oil Company and the overseas subsidiary of Standard Oil Company (Indiana). The latter paid the former $25 million for the concession which covers about 4 million acres. A heavy rig mounted on a mobile marine platform will be used.

AGIP, Italian company, which signed a 1957 contract, has 4 years before it must begin drilling. Sapphire Petroleums has a concession on the coast east of the Consortium area.

Nine drilling rigs were operating for Iranian Oil Participants Ltd.; 13 wells were drilled and 9 are producing. This makes 109 producing wells operated by the company.

Four geophysical and 2 geological crews are working in the area. One of the 6 wells brought in at Agha Jari flowed on test at the rate of 3000 b/d. Of the 6 established oilfields Agha Jaia is by far the largest, with an average production of 503,000 b/d.

Preliminary work was carried out before laying a 99-mile 26, 28, and 30-in. crude pipeline between Gach Saran oilfield and Kharg Island. Twenty-five miles of the line will be under the sea. On Kharg Island a new major crude oil loading terminal is being constructed.

Refining at Abadan was slightly lower than in 1957. During the year $63,700,000 was spent by the Iranian Oil Participants on capital projects.

Iran and Turkey have signed an agreement to build a pipeline more than 1000 miles long to carry oil from the state-owned Qum field to a Turkish Mediterranean port. Turkey will receive 23% of the transport profits for 5 years and subsequently 50%. The pipeline will cost about $500 million and the agreement is said to be for 80 years. No move has been made to implement the agreement.

An institute of petroleum is being established as part of Teheran University. It is sponsored by National Iranian Oil Company and experts from the French Institute de Petroleos in Paris will provide the nucleus of the staff.

IRAQ

Prod. 698,650 b/d **R. C. 55,830 b/d**
Runs 42,000 b/d

The civil war in Iraq left the country in a somewhat shaky political and economic situation. The new government would probably like to nationalize the Iraq Petroleum Company, but it desperately needs the $208 million paid by the Iraq, Basrah, and Mosul petroleum companies.

So far the government has not interfered with operations and they ex-

Revised Crude Petroleum Conversion Factors

Latest available data for converting crude petroleum quantities from metric tons to U. S. barrels of 42 gallons each. Multiply metric tons by the factors below:

	Factor		Factor		Factor
Albania	6.672	Formosa	7.610	Netherlands	6.975
*Algeria	7.731	France	7.201	*Neutral Zone	6.840
Argentina	6.992	Germany (West)	7.247	New Guinea	7.468
Austria	6.892	Hungary	7.630	*Pakistan	7.107
Bahrain	7.335	India	7.464	Peru	7.517
*Bolivia	8.123	Indonesia	7.369	Poland	7.419
Brazil	7.315	*Iran	7.395	Qatar	7.686
*British Borneo	7.508	*Iraq	7.411	Rumania	7.453
Burma	7.464	Israel	7.286	*Saudi Arabia	7.390
Canada	7.428	*Italy	6.813	Trinidad	6.989
*Chile	7.802	Japan	7.138	Turkey	7.240
*Colombia	7.049	*Kuwait	7.254	United Kingdom	7.279
Czechoslovakia	6.782	Mexico	7.104	United States	7.418
*Ecuador	7.432	Morocco	7.532	*Venezuela	6.871
Egypt	6.923			Yugoslavia	7.070

*Revised since issue of comparable table in International Petroleum Trade, Vol. 26, No. 10.

— *Provided by Bureau of Mines, Pittsburgh, Pennsylvania*

panded sharply in 1958 over 1957.

In meetings Dr. Ibrahim Kubba, Iraqi Minister of Economics, has said the question of nationalizing oil has not been discussed between the oil companies and the Iraq government. The new government is interested in getting the oil companies to relinquish their rights in territories unexplored by them. This has already been done by the Basrah Company, which relinquished part of its concession covering territorial waters. Rights of the Khanaqin Oil Company, a subsidiary of BP, ended in November, according to the agreement signed in 1951.

Latest operational move is construction of a deep water oil terminal for which contracts have been let, by Basrah Petroleum. The terminal will be able to berth two 65,000-ton tankers at one time.

IRELAND

The Minister for Industry and Commerce has entered into an agreement with Ambassador Oil Corporation, Fort Worth, Texas, for prospecting and developing any resources in Ireland. The agreement, which extends over the whole country and its territorial waters, stipulates that at least $300,000 will be spent the first 3 years, including drilling of an exploratory well to be at least 5000 ft deep. The remainder of the first 5-year period it must spend an additional $200,000. Prospects are not considered particularly good in Ireland, but there are oil seeps in the country.

The new refinery at Whitegate, County Cork, is expected to be completed this year. Irish Refining Company (Caltex, Esso, Shell Mex and BP) will cost about $35 million and will have a capacity of 39,600 b/d.

Consumption in Ireland, including ships bunkers, is estimated at 22,227 b/d. Imports of all petroleum products in 1958 were 22,989 b/d.

ISRAEL

Prod. 2500 b/d **R. C. 85,000 b/d**
Runs 26,000 b/d

In 1958 production of oil has increased from about 1500 b/d to close to 2500 b/d, all from the Heletz field, south of Tel Aviv. Geophysical work was increased in most parts of the country, totaling 23 party months in 1958. A small gas field discovery in northern Negev was discovered while drilling Zohar No. 1. An off-set was drilled on a 240-acre spacing. Each well is now producing some 500 mcf/d. Five rigs were operated in 1958. Reserves are estimated at 15 million bbl.

By the close of 1958 there were 39 exploratory licenses in force covering an area of about 4.2 million acres. These licenses were held by 6 foreign companies and 5 Israeli companies with foreign participation.

Oil exploration in Israel is based on Petroleum Law 1952, whereby licenses are granted for 7 years. Operators are exempt from local duties and customs on equipment and materials used for exploration, and they enjoy an income tax depletion allowance similar to that in USA and Canada.

The Haifa refineries which were built prior to World War II were transferred to the ownership of Posit Properties Ltd., a British corporation, with Israeli participation. A 6-in. product pipeline was laid between the refineries and Tel Aviv to replace transportation by trucks and rail tankers.

Demand rose 10½ % to 30,710 b/d.

ITALY

(AND TRIESTE. SEE SICILY)

Prod. 1,900 b/d **R. C. 633,000 b/d**
Gas 500 m³cf/d **Runs 559,000 b/d**

ENI, official oil and gas entity, has had considerable success in building gas reserves but has been unfortunate in discovering oil deposits on the mainland (See Sicily for ENI's production there). There was a serious proposal in the Italian Parliament that the concession in the north be reduced by 50%.

Wintershall A.G., a German firm, has combined with the government of Sardinia (Italian island) to explore the western part of the island for oil and gas.

Most of Italy's crude for its vast refining industry comes from the Middle East* and a recent contract calls for 4 million bbl of crude from USSR in return for 8000 tons of synthetic rubber.

Agreements for construction of a 260-mile oil pipeline has been reached between ENI and Societe Financiere Italo-Suisse, a Swiss financial group.

Work on the line is expected to begin this year and run for about 3 years, all materials to be supplied from Italy. The line will run from Genoa to Milan and then to Aigle, Switzerland, and is expected eventually to be extended into southern Germany. It will have a capacity of 30,000 b/d. A refinery with a capacity of 4000 b/d is to be built at Aigle.

Consumption continues to rise. In 1958 it topped 1957 by 11% at 235,000 b/d.

JAMAICA

At present no one is doing any prospecting on the island of Jamaica.

Permission has been given to Esso Standard to construct a 26,000 b/d refinery. This will be more than sufficient to cover the local consumption of 22,000 b/d.

JAPAN

Prod. 7021 b/d **R. C. 552,900 b/d**
Gas 35,579 mcf/d **Runs 277,400 b/d**

The Japanese oil industry continues to pursue diligently its search for reserves of oil and gas. In 1958, 751 holes were drilled which brought in 561 gas wells, 105 oil wells, and 85 dry holes. At the present time there are 3079 oil wells and 1055 gas wells producing.

Japan Petroleum Exploration Company (Japex) purchased an offshore drilling platform from LeTourneau. Japex is 56.5% owned by the Japanese government.

Refining runs were held down this year and were not much greater than in 1957. As it was, imports amounted to 281,000 b/d crude oil and 33,993 b/d products; 20,299 b/d products were exported. Refining capacity has increased by 13% since 1957.

Consumption went up by 6%, which is not indicative of the actual progress

*"Mideast Oil Vital to Italy," by Dr. E. G. Notten, *The Petroleum Engineer*, November 1958, Page E-1.

of Japan because legislative pressure held down imports to save convertible funds.

JAVA (Indonesia)

(SEE INDONESIA)

Prod. 5938 b/d **R. C. 7800 b/d**
Runs 6600 b/d

The small fields in Java have not been developed to any extent. They are operated by Shell as are the two small refineries on that island.

JORDAN

Phillips has acquired the operating rights of E. W. Pauley with the government of Jordan, which covers a third of the country. So far the company has drilled 3 wildcats without commercial success. A fourth well is being drilled about 10 miles northwest of Amman. Two other exploration concessions, each over about ⅓ of Jordan, are said to be in effect.

A 6500 b/d refinery is being built for the Jordanean Petroleum Refinery Company (part government-owned) by an Italian group. The refinery is near Zerka, north of Amman.

KENYA

Frobisher, Ltd., a Canadian company, has an 8000 sq mile concession in the northern part of the country. BP-Shell drilled 3 shallow wells in the northern coastal area.

Some reports have been made that Royal Dutch/Shell is negotiating with the government to construct a new refinery at Monbasa.

According to import figures, Kenya consumes about 12,950 b/d products.

KOREA

In 1957, there was a report of oil prospecting in northern Korea. The Wansum refinery there is probably operating again. At one time it had a capacity of 5000 b/d.

South Korea has no oil operations. It imports an average 11,100 b/d petroleum products.

KUWAIT

Prod. 1,395,569 b/d **R. C. 190,000 b/d**
Runs 119,880 b/d

A year of steady development resulted in an increase in crude oil production of approximately 22% over the 1957 figure.

Two new gathering centers in Burgan were brought into commission early in 1958, each with a throughput capacity of 180,000 b/d. This makes a total of 13 centers in operation and construction of another in Burgan began in December.

At the end of the year 3 rigs were engaged on development drillings in the established Southeast Kuwait fields, 2 more were on workover repairs and a heavy duty rig was engaged on exploration drilling some 20 miles west of the Burgan field. In North Kuwait, two contractor's rigs were continuously engaged on development drilling in the Raudhatain field where one well was completed and 15 drilled to depth for completion later when production facilities are installed.

A new field was found at Sabriya, some 9 miles southeast of Raudhatain, the discovery well being completed in early 1958. A step-out well on this structure was also drilled to depth for later completion.

Thirty-nine producing wells were completed in the Burgan and Magwa/Ahmadi areas during the year, making a total of 297.

Production from the Raudhatain area is scheduled to commence during the summer of 1959 and construction of a 30-in. transit line, approximately 63 miles in length, to the new tank farm at North Ahmadi is under way. Of the 15 tanks for the new tank farm, 6 have been completed. Crude will flow from this tank farm by gravity through three 38-40-in. lines to the new terminal.

The North Pier, 4 miles north of the present South Pier, is nearing completion. It will provide berths for 5 tankers of up to 65,000 tons loading simultaneously but will also be able to accommodate vessels of 100,000 tons and over. In 1958 an average of 1,273,995 b/d of crude and 58,822 b/d of products were exported. The two 80,000 b/d distillation units at the Mina al Ahmadi refinery were brought onstream in January and February 1958 respectively, thus increasing the throughput capacity of the plant to 190,000 b/d.

A 4070 b/d Hydrobon Platformer plant is under construction to provide high octane components for gasoline blending for the local market.

Improvements at the bitumen plant increased the charge capacity to 1000 b/d (450 b/d products). Gas production runs about 660,000 mcf/d.

Preliminary work was in hand at the end of the year for a compressor station capable of injecting 100 million cu ft of gas to repressure the producing reservoir.

KUWAIT-SAUDI ARABIA

NEUTRAL ZONE

Prod. 80,300 b/d **R. C. 50,000 b/d**
Runs 35,000 b/d

Production in the neutral zone has gone from 32,000 in 1956 to 62,000 in 1957, to 80,000 b/d in 1958. American Independent Oil Company (11 U.S. oil companies) and Getty Oil Company have all the production. Two drilling rigs operating during the year, drilled a total of 49 wells, which found production in 37. This means that 141 wells are now producing in the neutral zone.

An agreement was concluded between Kuwait and the Japanese-owned Arabian Oil Company, Ltd. for a concession offshore the neutral zone. Saudi Arabia had already given its consent. Besides the initial bonus the Japanese company will pay royalties and taxes amounting to at least 57% of profits from all production calculated on the basis of posted prices. The company must pay a production bonus of $5 million when the production level reaches 50,000 b/d. Also, the company is required to refine, transport, and market products when production has reached a level sufficient to justify such operations.

Reading and Bates offshore drilling company of Tulsa and International Drilling Company of the Netherlands, were awarded a 2-year contract to drill offshore the Kuwait neutral zone by the Japanese company. A seismic survey has been completed by Geophysical Service International. The drilling contract is valued at $7 million. It carries an option for the Arabian Oil Company to purchase the equipment at the end of the contract.

Perhaps the most important thing to happen in Kuwait in 1958 was the opening of the Getty Oil refinery at Mina Saud. A gathering center and pipeline carry the crude from the Wafra field to the coastal town.

LEBANON

R. C. 23,000 b/d
Runs 18,000 b/d

Two concessions—to a French firm and to a Lebanese-U.S. group have been granted recently.

Political unrest in Lebanon, Iraq and Syria discouraged oil activities in 1958, however. Pipelines from Iraq to the Mediterranean were both damaged and out of commission for a term. These lines carry some 150,000 b/d. Some goes to Tripoli where Iraq Petroleum has its plant; some to Sidon where Mediterranean Refining Company (Caltex-Socony) has its plant. Most of the Iraqian production is shipped abroad as crude oil.

Lebanese consumption is about 20,000 b/d.

LIBYA

Intense efforts of a half dozen oil companies have opened up oil deposits in Libya so that it is second only to Algeria in oil activity. Latest find is that of Shell Oil at Bir Tlacsin, about 120 miles southwest of Tripoli on the Mediterranean Coast. This is in the Tripolitania area, which is designated Zone 1.

Oasis Oil Company of Libya discovered oil in its first exploratory well,

Bahi A1-32 in north central Libya at 5822-54 ft. It tested 700 b/d. This company is a subsidiary of Ohio, held ⅓ each by Amerada, Ohio, and Continental. Oasis has drilled 2 wells and has 2 producers.

After two wells, the third test of Oasis appeared to be dry. Then a fourth well discovered a new sand this spring at 3160 - 230 ft. Two further wells are planned 5 miles south and 12 miles north of Bahi No. 1.

Esso Libya has made its second discovery recently. In 1957 the first successful test came in the province of Fezzan at Atshan, about 75 miles from the Edjele field in Algeria. Most recent Esso find is at the Zelten No. 1 well in the Cyrenaic area on the east side. The well flowed 100 b/hr from 5400 ft.

Texas Producing Company and W. R. Grace and Company have a joint enterprise in Libya. With one drilling rig they drilled 3 wells, all dry. Two geological crews and one geophysical crew is working on exploration here, and another test has been spudded.

Darcy Exploration (Africa Ltd.) a British Petroleum subsidiary, has one drilling rig working. It drilled 2 dry holes.

Mobil Oil of Canada abandoned its first test, Hofra No. 1, at 8500 ft with no production and is drilling another at present.

Gelsenberg Benzin AG, a German oil refining company, has acquired a 25% participation in the Mobil concessions in Libya. Mobil will operate the concessions and will have full control of exploration development and construction. The two companies already have some joint interests in Germany.

Compagnie des Petroles Total (Libye), wholly owned subsidiary of the Compagnie Francaise des Petroles, has had an encouraging show of oil between 4597 and 4675 ft in a well in the Western Fezzan, 80 miles from the Algerian border.

Gulf, which has 1 rig operating and 4 exploration crews in its concession, drilled 3 dry holes in 1958.

Standard Oil (Indiana) has exploration operations going on the 23 million acres covered by its concession.

Wintershall A. G., of Kassel, is to participate jointly in a concession covering 15,400 sq miles in the Fezzan acquired by Deutsche Erdoel A. G., of Hamburg, which will remain the operating company. Geological survey, and reflection seismic work by the Prakla Gesellschaft, of Hanover, began in December 1958.

In all, 41 geological crews operated in Libya during 1958, 24 seismic and 9 gravity crews. A total of 25 wells were drilled by 9 rigs, and 3 new fields were discovered.

MADAGASCAR

The big island of Madagascar off the east coast of Africa in the Indian Ocean has been explored for at least a decade, still without commercial production. The Societe Des Petroles de Madagascar (SPM) still has 2 drilling rigs on the island and is doing seismic, gravity and magnetic work.

MALTA

BP Exploration Company has the oil prospecting contract with the government of Malta. BP is drilling on its first wildcat and early this year was down 5000 ft, having difficulty in the operation because the subsurface was honeycombed with great breaks in the formation. The operators have discontinued pouring cement but are still drilling. Malta's consumption is 3439 b/d oil products.

MEXICO

Prod. 275,000 b/d **R. C. 357,000 b/d**
Gas 400 m²cf/d **Runs 297,000 b/d**

Pemex has indeed been fortunate in its director-generals. Antonio Bermudez, who served as head of the government monopoly for 12 years, left when President Adolfo López Mateos took office. In his place was appointed a dynamic financier and industrialist, Pascual Gutiérrez Roldán. Within a short time the cheerful, confident Sr. Gutiérrez had:

- Borrowed $40 million from 4 United States banks to construct a 600-mile 24-in. natural gas pipeline from Ciudad Pemex on the Gulf of Mexico to Mexico City. Pemex will supply an additional $3 million for the line that will have a daily capacity of 500,000,000 million cu ft. The line is to be completed in 22 months.
- Borrowed $20 million from banks in European common market, presumably to buy materials there.
- Obtained these credits for expansion:
  1. $9.1 million from Council of British Manufacturers.
  2. $50 million from a group of European banks to be spent in the common market.
  3. $7.5 million from a group of Mexican banks.
  4. $7.5 million from Lumus Company.
  5. $12 million credit from a Mexican steel mill with the backing of a group of American banks to extend product and natural gas lines from Monterrey to Torreón in central Mexico.
- Obtained authorization from the Mexican government to raise prices to commercial levels.
- Confessed he was reducing personnel so there would be an opportunity to lower product costs (now have 44,000 workers). The petroleum union is strong and strives to obtain ever increasing wages (present average daily salary: $4.64) Labor gets 24.5% of present income.

In 1958 there were 100 drilling rigs in operation, 40 of them doing exploratory drilling.

Production handles all domestic needs, which run about 280,000 b/d, according to Gutierrez, or 9% above 1957. He says demand will average 8 to 12% rise a year for the foreseeable future.

Pemex paid the government of Mexico almost a half billion dollars in 15 years,* the Director General said. It will not have to pay more until its debts are relieved. It now has a deficit of about $20 million and loans of $320 million.

Gutiérrez Roldán set a production target for 1959 of 303,000 b/d, an increase of 10% over 1958. Net oil exports earnings last year were $6 million and he hopes to enlarge this sum.

MOROCCO

Prod. 1559 b/d **R. C. 3250 b/d**
Gas 180 mcf/d **Runs 3157 b/d**

Only 2 companies have so far been active in Morocco. One was SCP which was formerly owned 40% by the Moroccan government and 40% by Bureaux de Recherche de Petrole, 11% by Compagnie Francaise des Petroles, and the rest held privately. Under new financial arrangements the Moroccan state will have a 50% participation in Societe Cherifienne des Petroles. The French BRP will be responsible for technical direction. The chairman of the company will be Moroccan.

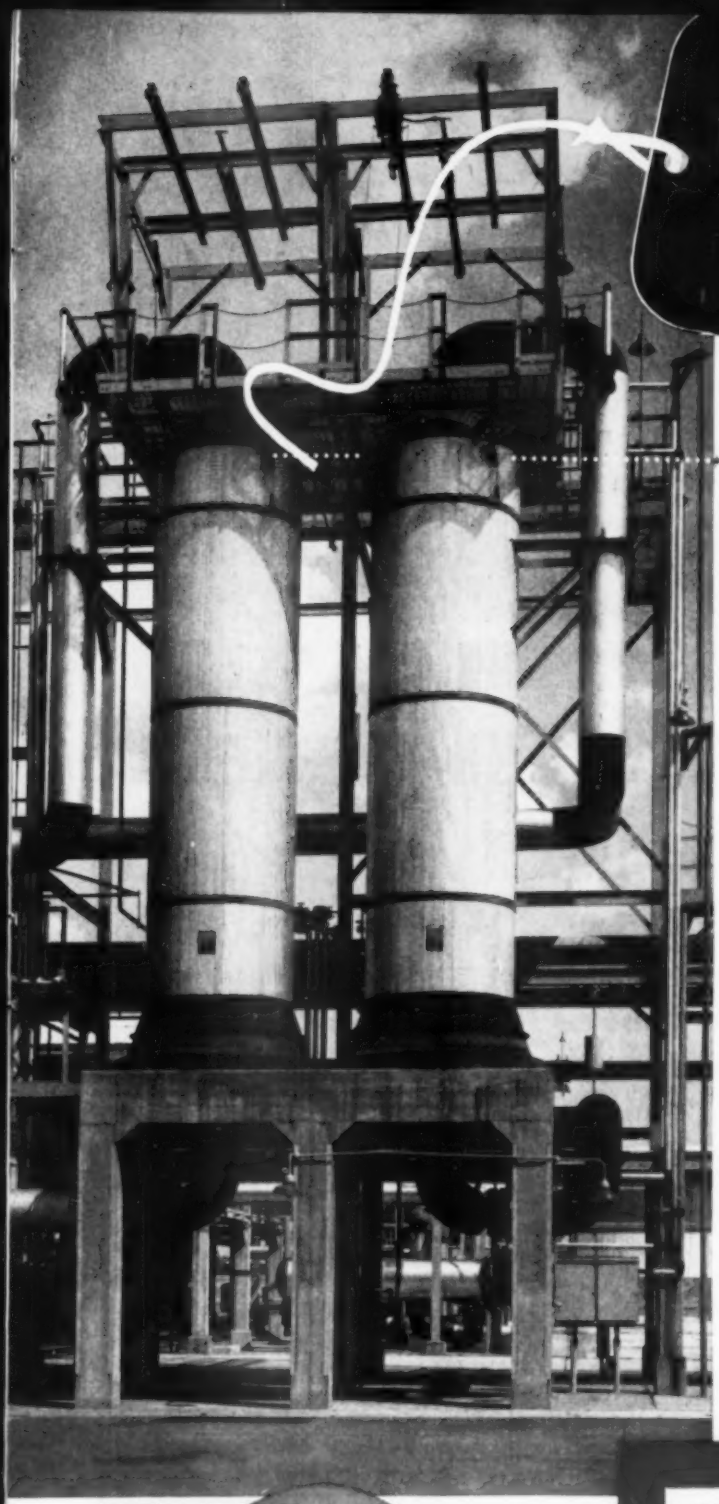
SCP has the only production in Morocco, which comes from small oil and gas fields in the northwest. Last year 14 wells were drilled to add 8 producers. Ninety wells have some production. There are 4 rigs working. A new crude oil line is being laid the 12 miles from Oued Beth fields to Sidi-Kacem refinery.

Only other concern is the ENI, Italian-state company, which concluded an oil agreement with Morocco in 1958. According to the contract, ENI will carry out exploration work through its subsidiary AGIP along the Atlantic Coast, including an under water strip. If commercial oil is found ENI will form a joint producing company with the Moroccan state, in which the latter will have a 50% interest. Expenses and profits will be shared 50-50 between the state and the new company.

Under a new trade agreement, the USSR will deliver 3000 b/d of oil to Morocco; 1700 bbl in crude oil will be used at the Petitjean refinery of SCP.

*This is about $30 million a year. A company like Sinclair, for instance, pays twice as much in direct taxes, collects much more for governments in excise taxes in the U. S.

To be continued in the July issue.



FABRICATED

WITH CARE

by CB&I

REACTORS

Catalytic Reforming Unit for
PHILLIPS PETROLEUM COMPANY
Kansas City Refinery

SPECIFICATIONS:

CONSTRUCTION: A301 Grade B Firebox
SIZE: 5-ft. 6-in. diameter by 30-ft. high
DESIGN PRESSURE: 700 pounds per square inch
DESIGN METAL TEMP: 985° F
PLATE THICKNESS: 3 1/8-in. shell
CATALYST USED: Metallic platinum, finely dispersed
CONTROL: Temp. & Pressure: Very CRITICAL
PRODUCT IN: Low Octane gasoline
PRODUCT OUT: High Octane gasoline

FABRICATING CONTROLS USED

✓ STRESS RELIEVED ✓ RADIOGRAPHED
✓ API-ASME CODE

DESIGNER: Procon, Incorporated
FABRICATOR: Chicago Bridge & Iron Company

Where there's refining . . . there's CB&I and for good reason. Increasingly complex refining operations *demand* the exacting attention to structural detail made possible by the advanced metallurgical control techniques employed by CB&I through every phase of construction. This *craftsmanship in steel* is the reason why CB&I-built structures have become first choice for efficiency and long service, *wherever* refinery products are stored and processed.

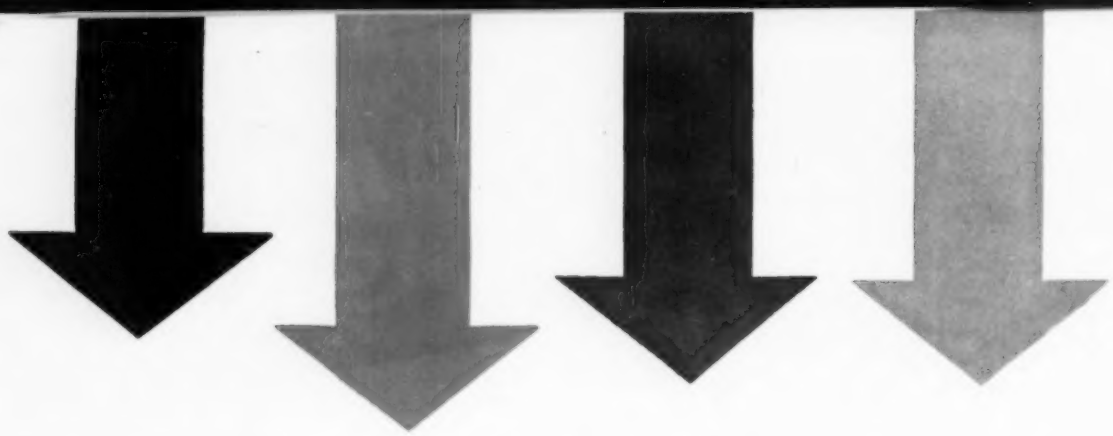
Write our nearest office for the CB&I bulletin: *Special Plate Structures.*

CB&I Fabricates
CB&I Engineers
Welded steel structures serve better and last longer . . . with CB&I Coordinated Services.
CB&I Erects

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, GREENVILLE, PA. and at NEW CASTLE, DELAWARE.
In Canada: HORTON STEEL WORKS LTD., TORONTO, ONTARIO
REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland
SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas; Chicago Bridge Limited, London; Sociedade Chibridge de Construcoes Ltda., Rio de Janeiro



When you need cathodic protection for underground structures it's the high silicon iron, DURIRON, that counts!

IN ALL ORDINARY CASES . . . DURIRON IS JUST AS GOOD AS GRAPHITE; AND IN THE REALLY TOUGH CASES, DURIRON ANODES ARE BETTER

1. Unexcelled corrosion resistance
2. Good electrical properties
3. No current density limitations
4. No undesirable corrosion products
5. Easy to install

STANDARD DURIRON ANODE SIZES

Type Anode	Size	Area Sq. Ft.	Weight (Lbs.)	General Application
B	1" x 60"	1.4	14	Fresh Water
C*	1½" x 60"	2.0	25	Ground Bed
D	2" x 60"	2.6	46	Ground Bed
E	3" x 60"	4.0	115	Salt Water
G	2" x 9"	0.4	5	Ducts
J	3" x 36"	2.5	80	Salt Water
M	2" x 60"	2.8	57	Salt Water

* Applicable also in fresh water service. Should not be used in ground beds without backfill.

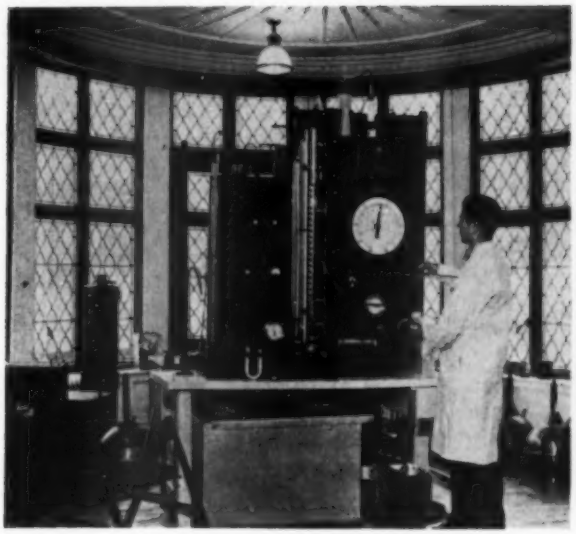
Go all the way with the high silicon iron, Duriron*. Its superiority in marshlands, at river crossings, and wherever backfilling is impractical or imperfect has been proved without question. And in all perfect backfill cases (where the anode is merely the conducting rod) Duriron serves exactly the same purpose as graphite, and just as well.

Duriron anodes have proven their superiority for the cathodic protection of pipelines, drilling rigs, well casings, storage tanks, gathering lines, communications cables, and similar systems. For positive protection, insist on DURIRON.

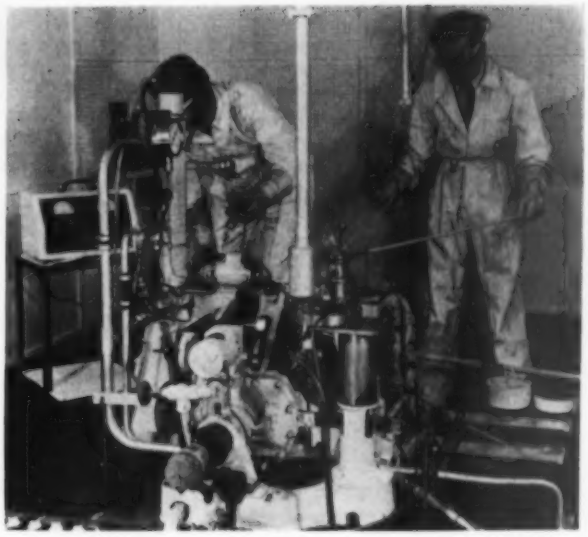
* *For high chloride environments, The Duriron Company manufactures the molybdenum containing high silicon iron, Durichlor.*

THE DURIRON COMPANY, INC. / DAYTON 1, OHIO

DURCO



Petroleum engineering high-pressure laboratory. Investigation of phase behavior of complex gaseous hydrocarbon mixtures. Purification of single component by low temperature fractionation in progress.



Radio-active isotopes measure engine wear. Scientists at Sunbury-on-Thames using special long-reach tools and wearing protective gloves and eyeshields, are seen fitting a radio-active piston ring to the special test engine.

Research at Sunbury

British Petroleum, founded 50 years ago, has one of the industry's top research organizations. This is how the big center is set up.

V. S. Swaminathan

DEVELOPMENT OF RESEARCH in The British Petroleum Company is typical of what has taken place in the oil industry generally. In 1917 a house and grounds were purchased at Sunbury-on-Thames southwest of London and an embryo research organization was founded with a staff of two chemists. The limited quarters soon became inadequate and year by year new buildings have been erected.

British Petroleum, which celebrates its Golden Jubilee this year, began its research eight years after its founding.

Sunbury Research Center has now grown to a staff of some 1200 persons and covers an area of 19 acres. During 1956 and 1957 three new laboratories, a new workshop, and a new restaurant were completed. Last year a new stores building and fire station were commissioned and further buildings are under construction and design.

The BP Research Center studies problems connected with all phases of the oil industry. To carry out its functions, the Center is divided into a number of technical groups. There is close cooperation between groups and many projects are combined operations by chemists, physicists, engineers, mathematicians and other scientific and technical personnel.

The various laboratories and workshops have been specially designed for their tasks and are provided with a full and complex system of services.

The Center is organized in four main divisions: (1) Exploration, (2) Petroleum, (3) Chemicals, and (4) Administration.

Exploration Division

BP Exploration Division Laboratory moved in 1957 into a new building, built for it on the Sunbury site.

Its functions include investigating the characteristics of underground formations to determine the possibility of oil recovery; determination of physical characteristics underground of oil when found; estimating the extent, probable recoverable reserves, and most economical method of developing and exploiting an oilfield; investigating methods of secondary recovery and forecasting when this should be applied; and dealing with the economical separation of the high-pressure gas and oil mixture at the well head.

Work of this division is divided into five sections.

Geology (including Geochemistry). BP is actively engaged in a world-wide search for new oil fields, in order to ensure adequate recoverable reserves.

The section is studying sediments from the present day sea-floor which it compares with rocks encountered during drilling for oil. Both the physical nature and chemical composition of sedimentary rocks are studied. Attention is directed to the small amounts of organic matter found in many of them, as it seems probable that in the past such organic matter has been transformed to petroleum.

Palaeontology (including Palynology). This section carries out detailed examination of outcrop rock samples collected by geologists on survey work in various parts of the world, as well as samples from information borings and test wells. Since it is sometimes very difficult to decide on the approximate age of a rock, a thorough search is made of samples for fossils which

give a clue to their age. Palynology, which is the study of fossil spores and pollen, may give some indication of the age of a rock when other fossils are absent.

Geophysics. Both research and development in geophysical methods of prospecting for oil and in the instruments required are studied here.

Most precise means of prospecting is the seismic method and most of the section's effort is devoted to this.

Many of the section's facilities are employed in the devising of new or improved instruments and in modifying existing field techniques and instruments to suit the conditions of the areas in which the company is looking for oil.

Research work is also going on to develop a gravity measuring instrument which will go down a deep borehole.

Petroleum Engineering. The engineering section is concerned with measurements on reservoir rocks, oils and gases, and the production performance.

Measurement in boreholes, by electrical and radioactive logging equipment, of the changes in rock characteristics, are made in the United Kingdom by the borehole survey group. The reservoir engineering group studies the oil production performance of oilfields and predicts their future potentialities.

Production Engineering. When the best method of developing and exploiting an oilfield has been agreed it remains to develop the surface plant and equipment forming the final link between the wellhead and the shipping point or refinery. The study of separation processes and the design of suitable plant and equipment is part of the activities of production engineering section.

Research is also carried out into the more fundamental physical properties of the gases, the crude oil and their individual components. Such data is necessary in developing additional recovery processes in the field such as the liquefaction of the field separation gases and their transport.

Petroleum Division

The Petroleum Division's main functions are to improve the knowledge of the constitution of crude oil, so as to make the best use of this valuable raw material; to study ways of reacting or converting hydrocarbons, with the object of devising new or improved processes for refining crude oil; to ensure that the quality of BP products meets the requirements of the market; and to provide such technical assistance as the sales organizations require in the marketing of these products. Work of the division is divided into seven main sections.

Basic Research. This section seeks fundamental chemical and physical information. Much work has been done over the years in identifying the individual components in crude oils including compounds containing sulfur, oxygen, nitrogen, vanadium and nickel as well as hydrocarbons. A first requirement in this work is the development of techniques for efficient separation. Among the newer techniques employed are thermal diffusion and gas-liquid chromatography.

This section also uses a linear accelerator to generate high energy electrons, gamma rays or neutrons which can be made to initiate reactions in hydrocarbons and other molecules. The study of the reactions so induced gives useful basic information.

Process Research. Here chemists and chemical engineers investigate, on the pilot plant scale, new methods of refining or processing. These new techniques may have originated within the Sunbury Research Center or have been offered by outside licensors.

Two refinery processes which are closely associated with Sunbury are alkylation and "Autofining." The alkylation process was originally developed at the station in 1936 as a means of producing a high octane component for aviation gasoline from certain petroleum gases. "Autofining," which was fully developed at Sunbury, is a process for the catalytic desulfurization of petroleum distillates. It has been applied with particular success to the refining of tractor vaporizing oils and gas oils.

Applied Physics. Many of the problems encountered in the refining, testing distribution and use of petroleum products are predominantly of a physical rather than chemical nature since no chemical change is involved. Problems of this type are investigated by the Applied Physics and Chemical Engineering section.

They include the provision of prototype instruments and the use of new types of instruments; the application of mathematical and statistical techniques in the oil industry; and the study of physical and engineering problems, such as liquid flow, filtration, combustion and corrosion.

Corrosion costs industry many millions of pounds a year by shortening the life of plant and pipelines and research into its various forms is the responsibility of this section. Closely allied to this work is that of the metallography laboratory which examines structures of metallic materials of construction or test pieces used at Sunbury or elsewhere.

Application Research. In this section the factors associated with the use of fuels and lubricants in engines and other industrial machinery are evaluated.

Engines and test rigs of many makes and types are used for evaluating motor, aviation and diesel fuels and lubricants for all automotive and industrial applications.

Products Research. Primarily concerned with the quality of BP's marketed products, work here aims at insuring that the quality of products which range from gas through motor and aviation gasolines, diesel and furnace oils to bitumens and specialities, meets the requirements of the customer.

Analytical Section. This section has two main functions — the first being to provide an analytical service to the rest of the Research Center, and the second involves the study and development of methods of analysis.

The analytical section takes an active part in the Standardization of Test Methods sponsored by the Institute of Petroleum. It prepares preliminary plans for the design and layout of refinery laboratories and disseminates information regarding current analytical problems and advances in analytical techniques made at the Sunbury Research Center.

Technical Information. To enable the company's scientists to cover the wide field of activity which is their concern, it is necessary for them to read widely and to keep abreast of the latest scientific and technical developments. To help them do this there is the Technical Information section at Sunbury which keeps them informed about new publications and patents, and organizes and disseminates the mass of information which reaches the research center. The Technical Library contains well over 15,000 works and deals regularly with more than 300 journals.

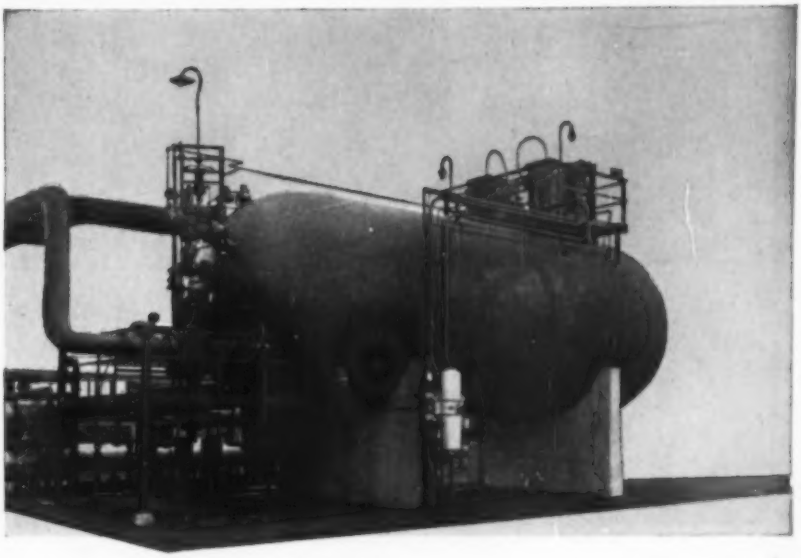
Chemicals Division

This relatively new division has been formed as a result of the company's growing activity in the petroleum chemicals field. BP now has interests in joint ventures with chemical companies in the U. K., France, and Germany. The division at Sunbury is to carry out research and development on processes to give new or improved chemical products. As yet Chemicals Division is not sufficiently large to be divided into sections.

It must be remembered the investigations at Sunbury are not only of value to the company. Its research efforts benefit the oil industry as a whole and indirectly the whole community. It is one of many fine centers that push the frontiers of science forward to bring safety and comfort and convenience to the industry's customers. ★ ★ ★

PRODUCT IMPROVEMENT WITH

PETRECO



facts to consider

WHEN YOU SPECIFY DESALTING EQUIPMENT

1 EFFICIENCY IS MEASURED IN TERMS OF REMAINING IMPURITIES. The ultimate measure of any desalting process is its thoroughness in removing salts and impurities—*not how much salt is removed, but how much salt is left in.*

PETRECO* all-electric desalters consistently deliver desalting results with residual impurities in the 0 to 1 ptb range.

2 SALT "SETTLING" IS NOT TRUE DESALTING. Salt settling is one way to remove salts, but desalting is something else. "Settling", using long "residence time" in large volumetric capacity settlers, was one of the first methods ever used to remove salts.

Petreco all-electric desalting is an engineered method for the extraction of salts from crude oil. The mixture of the oil and salt-bearing brine is combined precisely with the correct amount of fresh water, and exposed to the powerful forces of the electric field to achieve fast, efficient separation.

3 TIME, DISTANCE AND SETTLING SPACE ARE NOT IMPORTANT FACTORS IN PETRECO ALL-ELECTRIC DESALTING. These natural developments are vital only to desalting methods wherein settling is necessary to the functioning of the process.

In Petreco all-electric desalting, engineered emulsification, distribution and demulsification bring about rapid, controlled action.

Because of this, Petreco desalters are usually smaller than vessels used in less advanced methods. This means savings in the cost of the vessel required, the amount of piping and the ground area needed—and yet provides a maximum yield in salt removals.

Remember—when you specify your next desalting installation, there is no substitute for Petreco's engineering design.

*PETRECO *is a registered trade mark of Petrolite Corporation.*

DS-59-1

PETROLITE CORPORATION

PETRECO DIVISION

3202 South Wayside Drive (P.O. Box 2546), Houston 1, Texas
1390 East Burnett Street (P.O. Box 7216), Long Beach 7, California

CANADA: Petreco, 4528 Stanley Drive, Calgary, Alberta

ENGLAND: Petrolite Limited, 46 Mount Street, London, W. 1

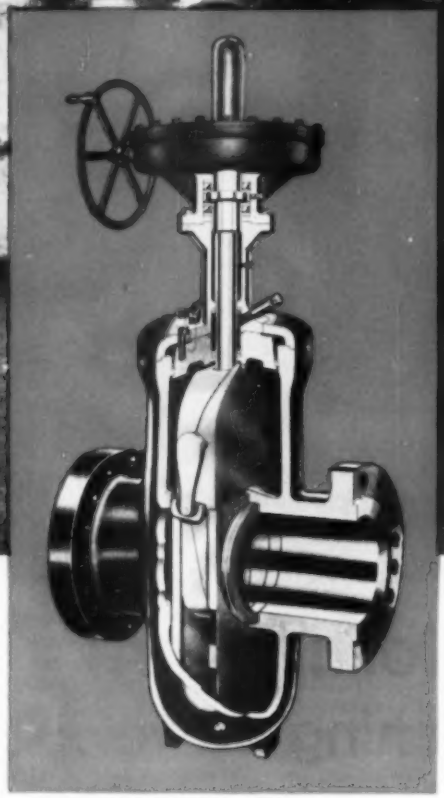
VENEZUELA: South American Petrolite Corporation, Hotel Avila, Caracas

REPRESENTATIVES

BRAZIL: WEROO, Ltda., Avenida Rio Branco 57-s/1410-11, Rio de Janeiro
COLOMBIA: South American Petrolite Corporation, Calle 19, No. 7-30, Office 807, Bogota
ITALY: O. Wagner, 149 Via Nemorense, Apt. 1, Rome
JAPAN: Chiyoda Chemical Engineering and Construction Company, Ltd., Tokyo Bldg., No. 3, Marunouchi 2-Chome, Chiyoda-Ku, Tokyo
KUWAIT: F. N. Dahdah, Box 1713, Al Kuwait
MEXICO: R. E. Power, Sierra de Mijes, No. 125, Mexico D. F.
NETHERLANDS: F. E. C. Jenkins, Hoefbladlaan 134, The Hague
TRINIDAD: Neal and Massy, Ltd., Port of Spain, P. O. Box 544

Progress is a thing easily seen and appreciated by men everywhere—when such progress is so easily demonstrated by CROSE pipeline construction equipment. Crose equipment on the job means more speed . . . more efficiency . . . more economy . . . a symbol of progress in the lives of peoples in many
CROSE
... an international name in pipeline construction equipment
lands. Crose has numerous supply points to expedite pipeline construction work in almost any corner of the world.
FOR THE BEST, USE CROSE—ANYWHERE!
M.J. Crose
MANUFACTURING COMPANY, INC.

2765 DAWSON ROAD • PHONE WEBSTER 6-2171 • TULSA, OKLAHOMA • BRANCH OFFICES: HOUSTON • DENVER • LOS ANGELES • ELIZABETH, N. J. • IN CANADA: CGO•E-CURRAN LTD., EDMONTON, ALBERTA • EXPORT OFFICE: NEW YORK, N. Y.



Leverlock* Gate Valves — A W-K-M Exclusive

W-K-M Pipeline Valves open **free** and close **easy** against any pressure within their rating. An exclusive centralizing mechanism—found only in W-K-M Leverlock Valves—positively holds the gate and segment assembly in a retracted position so that it will move freely between the seats when the valve is being opened or closed.

When the gate and segment reach the fully open or fully closed position—and only then—the centralizing mechanism releases to permit the gate and segment to expand and seat tightly against the upstream and downstream seats.

On Hand

Order 2-inch through 12-inch sizes from your supply store. Larger sizes to 34-inch available on special order from factory. Sizes 6-inch and larger are Leverlock Valves. ASA 300 pounds to ASA 1500 pounds.

*Trademark of ACF Industries, Inc.

The W-K-M® Through-Conduit Gate Valve is your valve

W-K-M's creative engineering designed this valve to solve *your* pipeline valve problems. It has been produced to meet your specifications for strength, long life and economy. Before it reaches you, it will have undergone rigorous and thorough testing.

That's why field men recommend the W-K-M Through-Conduit Gate Valve, why engineers specify its use. Its reputation inspires confidence—its dependability has been proved in service throughout the world.

It's *your* valve; specify and use it. *Write for Catalog 300: W-K-M Division of ACF Industries, Incorporated, P. O. Box 2117, Houston 1, Texas*

W-K-M SERVING INDUSTRY 40 YEARS

NEW Rockwell-Nordstrom Steel 1000-lb. Round Opening Valve . . .

Spring seated plug has full round opening. "O" rings seal to atmosphere and Sealdport® lubricant grooves stop leakage of lightest gases or heaviest fluids.

The new Rockwell-Nordstrom 1000-lb. inverted plug valve is designed to give valve users all the *proven* benefits of lubricated plug valves, plus the advantage of a full round opening in smaller size valves. Here are just a few of the advantages of the new inverted plug valve:

1. LOW TORQUE: "O" rings replace conventional packing gland . . . plug is lubricated for easy turning . . . rugged spring maintains perfect seating.

2. FULL ROUND OPENING: No cavities . . . minimum pressure drop . . . easy access for scraping.

3. SIMPLE, RUGGED DESIGN: Compact dimensions save space, fewer parts mean fewer repairs.

Rockwell-Nordstrom 1000-lb. round opening valves are now available in 2" x 2 1/16" size with API line pipe thread for production, pipeline, refinery, marketing, marine and process services; and with external upset threads for Christmas Tree services. Also available in 2" size with flanged ends (300-lb., 600-lb. class). For complete details, see your supplier or send the coupon below. Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

Lubrication makes the difference

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

SEND COUPON FOR COMPLETE DETAILS

Rockwell Manufacturing Company
Pittsburgh 8, Pa.

☐ Please send Bulletin V-611 on the new Rockwell-Nordstrom inverted lubricated plug valve.

☐ Please have a Rockwell Field Engineer call me for an appointment.

Name_____ Title_____

Company_____ Address_____

City_____ Zone____ State_____

Think About Those Below You Too

Gerald F. Bassler

"Conform as little as is necessary for good manners, good relationships and the highest use of individual talent." — Thomas Jefferson

RECENTLY, Norman R. F. Maier, professor of Social Psychology at the University of Michigan, reported some research findings that highlighted a problem of supervisory relationships with subordinates.

He reported "the worst area of disagreement between the two levels of supervision lies in the area of the subordinate's problems. The 'higher' executive has little conception of his subordinates' problems, and in addition he seems to have great difficulty in understanding those problems."

Workers and their bosses have traditionally had difficulties in communicating and this study further explores this problem. It would seem to point to the conclusion that this is a problem affecting all those who are in superior or subordinate positions. This is of particular import to those who aspire to management positions — *and rewards.*

Only 6 percent of the bosses, Maier points out, agreed highly on their views of the subordinate's work problems — 74 percent had low agreement. The researchers conclude that it is the rare boss who knows very much about his immediate subordinate's job.

Behind all this lack of communication is the subordinate's fear and feelings about his advancement opportunities. This leads to the development of "yes men," who find some security in agreeing with the boss. The psychologists state that workers are more likely to tell their bosses what they are achieving in their jobs, rather than the problems they encounter. Thus, the boss receives very little information which will reflect unfavorably on the subordinate.

This University of Michigan study highlights a subject of key importance to those who want to be managers — that of the complex relationship of a man and his boss. I want to examine this relationship from the viewpoint of the subordinate.

One of the first items to consider is that the superior-subordinate relationship is basic to nearly all industrial organizations. This organization relationship is modeled after the military and places the subordinate in an inferior organization position to his superior. Thus, the implication may often be that he is an inferior person. This, of course, is not so.

It is easy to see that, like the weak link in the chain, a poor subordinate-supervisor relationship can materially affect the kind of results an organization can obtain.

In earlier chapters in this series there have been discussed some other dimensions of this basic relationship — the functions of management, your aspirations for the future, management objectives, and basic industrial psychology. These have been discussed primarily from the superior's point of view. Let's take a look at how the subordinate sees himself and his goals as related to his boss.

O. A. Ohmann, manager of Employee Relations, Standard Oil Company of Ohio, suggests three basic concepts that guide the subordinate's thinking and action. He says that each subordinate employee wants:

1. *To be his own boss* — he wants to run his own show, to be wholly responsible for getting the job done. He wants to demonstrate his capability.
2. *To have a whole job* — rather than a meaningless segment of it. He wants a job involving planning, executing, and evaluating results — and he wants a job which is a challenge and in which he can find self-expression.
3. *To have individual integrity and dignity* — he wants to convert his relationship to his boss from one of personal power to one of social contact based purely on the requirements of work.

The examination of these ideas will be most fruitful in understanding what makes the man below tick. So, using these three thoughts as a base for exploration, let's "THINK ABOUT THOSE BELOW YOU TOO."

TO BE HIS OWN BOSS

Of course, no one who works for another can achieve this goal 100 percent. This doesn't mean, however, that we should go to the other extreme. We should try to set up conditions that will permit us to achieve a reasonable facsimile of this kind of freedom. Crawford H. Greenewalt, president of DuPont had this to say:

"The organization is in trouble when success causes it to be so enraptured with its accomplishments that it is moved, like Narcissus, to fashion everything to its own image. *I would venture the assumption that each of us,*

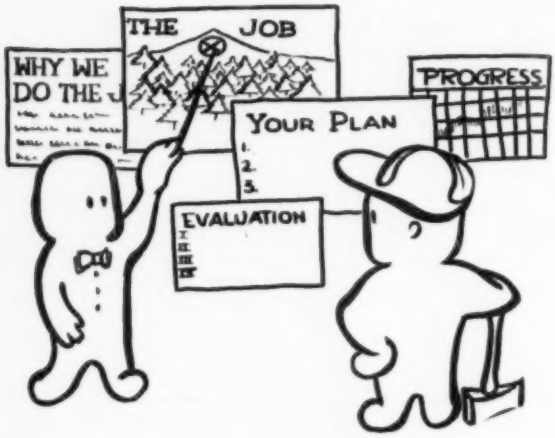
Gerald F. Bassler, *Continental Oil Company's Director of Personnel Development, is responsible for developing and coordinating company-wide policies and plans in the area of personnel and management development.*

A native of New York City, Mr. Bassler received his bachelor's degree in industrial education from Stout State College, Menomonie, Wisconsin, in 1939, and did graduate work at the University of Tennessee and Ohio State University. A sea-going sailor, attaining the rank of Lieutenant Commander, he was also a training administrator for the United States Navy during World War II.

Mr. Bassler has been senior training supervisor for Creole Petroleum Corporation in Venezuela, and management development supervisor of the Murray Corporation, Detroit.

whatever our vocation, has at some time passed through an unhappy period, caused by the boss' insisting that we 'do it his way' instead of letting us use the methods that fell most easily to our hands.

"Great emphasis is placed on training, particularly in that nebulous area called executive development, but too much codification in our training procedures can result in perpetuating a facsimile and freezing rigid patterns of thought. Thorough training is obviously a necessity but it must always be remembered that organizations do not make men — it is men who make organizations; it is what they bring with them in the way of character and adaptability and fresh ideas that enrich the organizational bloodstream and insure corporate longevity."



He wants to understand his job and pursue it under his own steam.

A way of enlisting the subordinate's energies and interests in accomplishing the organization's (boss') objectives is suggested by Richard R. Crow, regional manager of Industrial Relations for the Continental Oil Company. He says the following steps are essential.

1. **Achieve a common understanding concerning the subordinate's job.**
2. **Achieve a common understanding of the relationship of the subordinate's job in the organization.**
3. **Encourage the subordinate to establish goals for progress both on the job and in terms of personal skills. Within reason, give him room to set his own targets and goals for his job.**
4. **Develop with him a procedure for evaluating his results and progress.**
5. **Provide necessary guidance and encourage self-development.**

People in organizations can be frustrated, lost, and overlooked — promises can be forgotten — ambitions overly encouraged — and, occasionally, injustices may be done. This is the challenge of leadership, to see that these instances are minimized, if not avoided altogether.

The functions and the opportunities of individuals will obviously differ with their capacities and interests. Creative imagination will be expressed in varying ways and in varying degrees. Some will contribute in a brilliant, outstanding way, while others through their steadfastness of purpose or through the frequently overworked grind of hard routine work. The important lesson to be learned (and remembered) is that each employee must have the opportunity to realize his full potential in a way that recognizes his uniqueness as an individual.

TO HAVE A WHOLE JOB

One of the real problems society faces in today's highly industrialized culture is how to make work meaningful to the individual. One of the effects of scientific management has been to break whole jobs down into small segments in order to meet the standards of mass production. This has naturally had the effect of reducing the contribution each individual employee can make — and is directly opposed to man's desire to have a whole job.

We seem to be learning that the assembly line is not the best way to design human work. It is poor design of *machine* work. Some students of management seem to feel that wherever we find single motion — single step operations — that these can and should be mechanized. To ask man to do work that can be done by a machine is demeaning and unproductive.

Peter F. Drucker, management consultant and business educator, says "We have two principles, therefore, rather than one. The one for mechanical work is Mechanization. The one for human work is Integration. Both start with systematic analysis — layout work in logical sequence. Both focus attention on each motion — to make it easier, faster, more effortless. *But* the one organizes the motions *mechanically*, so as to utilize the special properties of the machine to do one thing fast and faultlessly. The other one *integrates* operations, so as to utilize the special properties of the human being to make a whole out of many things, to judge, to plan, and to change."

Thus, if we as managers are to consider those below — our subordinates — our task is not to break down jobs into simple one-step operations, but rather to put a job together into an *integrated whole*.

Let's look at some of the ways in which this can be accomplished. The real challenge is how can we put into each job a sense of responsibility. This, of course, means that every human job must have elements of planning, skill, and judgment. There should never be people jobs that require none of these things.

To bring this idea into focus let's consider two examples, which represent high and low ends of a scale. First, let's consider a surgeon.

This, perhaps, is the ultimate model, because any lack of skill, sense of responsibility, or error of judgment could result in death. While many improvements in surgical technique came about through the application of scientific management, the surgeon still has to do the whole job. Once he makes the first incision he must continue step by step until the last stitch is knotted. This is the ultimate in integration.

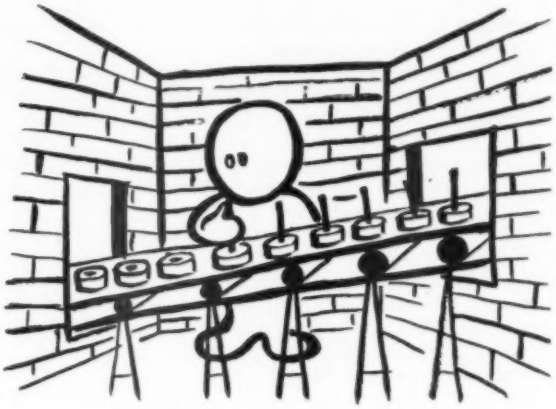
Less demanding, perhaps, but still meaningful is the work of the oilfield pumper. He has a whole job in that he is responsible for maintaining production from his wells; he has to plan how and when he will schedule maintenance operations; and he has to make decisions, which could be costly if wrong.

There are jobs, to be sure, that would challenge the wisdom of Solomon to make meaningful and whole. Your answer to this problem is to either mechanize it or integrate it.

Let's take a look at "job enlargement" as one approach to integration. We can best illustrate this by a story that is attributed to Thomas J. Watson, president of International Business Machines. He encountered an operator sitting idly by his machine. When asked why he wasn't working, he said that he was waiting for a set-up man. Watson asked if he could do it, and the operator replied that he could. Watson

later found that all operators had a number of hours waiting time each week. As a result, all operators were trained to set up their own equipment. Subsequent investigation revealed that the operator could also do his own inspection, so this too was added to his job.

In the Detroit Edison Company, Douglas J. Elliott has



He wants to hold a whole job — or at least understand it — not a robot's job.

achieved considerable success in "enlarging" the jobs of machine accounting employees. Rather than have a billing clerk do nothing but prepare final customer statements, the clerk may also be responsible for checking all source papers and data which result in the final statement. Enlarging the job in this way resulted in improvements in both quality and quantity of production. As a result, other jobs in this department were similarly expanded.

One of the significant ideas in the Edison approach is that employees themselves were involved in the redesign of their jobs. This is particularly important because it increases employee interest in their work and provides them with a real stake in improving their performance.

Just how critical the idea of employee participation is in job performance can be demonstrated by the following examples of results obtained when employees had a voice in setting standards.

1. A furnace cleaning job was cut from 4 to 2 days.
2. Tardiness was cut from 10 to 3 percent.
3. Service call errors were reduced from 1 in 14 to 1 in 23.
4. Over 60 tank cars were handled rather than 55.
5. Men worked more days in inclement weather when they had a voice than when the supervisor made the decision.

This idea is clearly defined by Professor Norman R. F. Maier of the University of Michigan when he says, "When groups of people work together, morale is highest if each one is not merely allowed, but is actively encouraged, to participate in achieving a common goal. Every person should be made to feel that his efforts are important, for when a person feels indispensable, he is most likely to cooperate."

TO HAVE INDIVIDUAL INTEGRITY — DIGNITY

Whether your subordinate has *a whole job that he owns* will mean very little if his relationship to you is not based on mutual trust and respect. One of the important elements in your success as a manager will be whether you can develop such a relationship with your employees.

During the last 20 years a quiet revolution has been going on. The supervisory-subordinate relationship, which for centuries was based on an authority-obedience concept, is tending to become one which is based on participation-cooperation.

This is no happenstance. Starting with World War II, particularly in the armed forces and defense industries, psychologists began an intensive study of the individual and his relationship with superiors, peers, authority, discipline, and other critical factors. Their objective was to better select, better train, better utilize, and better motivate the individual so his contribution to the war effort could be increased. The results of these studies led to further studies after the war.

One of the more significant studies in pointing the way toward enhancing the status of the subordinate employee through participative leadership was the following.

In a clothing factory, job changes occurred frequently and were nearly always accompanied by a sharp drop in production. It was suggested that the situation could be improved by employee *participation* in planning and carrying out a change. Three experimental groups plus a control group were set up. Throughout the study there was no change in the way the control group was treated.

Group I was told, in a meeting, what changes were to be made and why. They elected several representatives to help in working out a new method and rates.

Groups II and III also had meetings — but they *all* participated in how the work was to be done and in deciding new rates.

Prior to the change all groups had a production rate of about 60 units per hour.

The figure shows what happened. Productivity of the

He wants to be a person — not a job or a number.

control group dropped and did not return to normal level of 60 units. Group I productivity dropped but quickly recovered and advanced to a slightly higher rate than before the change. In Groups II and III there was no loss of productivity and went to a higher level than before.

We have here a striking example of how two different styles of leadership can affect the attitudes of employees and their rate of productivity. It should be noted that the morale in Groups II and III was higher than in the other two groups.

In addition to encouraging employee participation, supervisors have generally found that the following have helped to give employees a sense of dignity.

1. Stating objectives clearly.
2. Setting reasonably high standards.
3. Being sincerely interested in the individual.
4. Recognizing work done well.
5. Being sensitive to employee attitudes.

The manager who effectively utilizes these factors inevitably provides a base for maximizing his employees' performance. He has laid the foundation for effective motivation, and this is important because from sound motivation comes sound attitudes, and employee attitudes are the wellsprings of production.

It has been said, and truly so, that the best work is done by people who are healthily dissatisfied with things as they are. This kind of dissatisfaction can be the most valuable asset a company can possess in its employees — the best expression of pride in job and work, and of responsibility. A well-developed sense of responsibility is the best source of self-motivation for performance. We need to encourage it.

A noted writer on management suggests four ways to help subordinates develop a sense of responsibility:

1. Careful selection and placement,
2. High standards of performance,
3. Information on job progress and results,
4. Opportunities for participation.

Nothing challenges an employee so much as the knowledge that he has been selected above others and has been placed in a job that makes high demands of him. We should not drive people — they must drive themselves, and the only effective way to do this is to hold high standards for them to achieve.

Your employee wants and needs information. Most managers and employees consider two kinds of information essential to building responsibility and improving performance. Information on job progress and results is of primary importance, and information about the company which affects the individual's job and his contribution to the success of the company runs a close second.

The conventional method for providing information on job progress and results is employee evaluation. In this approach the following steps are normally taken:

1. Determine job factors to be measured.
2. Evaluate performance on each factor.
3. Summarize employee strengths and weaknesses.
4. Review with employee and plan for improvement.

This approach is based on the concept that the manager is the most appropriate person to make performance judgments about his employees. You'll recall that in Crawford Greenewalt's statement, he said: "... each of us has had unhappy periods caused by the boss' insisting that we 'do it his way'." We need, then, a way that will let people know the boss' requirements for a job that is well done and yet permit them some freedom in how they go about it.

We have developed in the Continental Oil Company an approach that we feel satisfies these requirements. In action, this system looks like this:

1. **Supervisor establishes objectives.**
2. **Employee and supervisor set performance improvement goals.**
3. **Employee analyses progress toward goals.**
4. **Joint review of progress toward goals.**

Actually, the basic difference in these approaches is one of attitude. The manager adopting the "goal setting" approach to performance review and appraisal would be less concerned with what *has happened in the past* — but is vitally interested in *planning for the future.*

He continues to appraise performance just as he always has — the difference is that he now appraises to help his employees achieve work goals previously established, rather than criticizing past performance. Appraisal becomes a means of reviewing progress, and counseling a means of guiding and encouraging improvement.

SUMMARY

Will you be the kind of manager who demands, "Do it my way," or will you heed the words of Thomas Jefferson when he says, "Conform as little as is necessary for good manners, good relationships, and the highest use of individual talent."

The manager's job has frequently been defined as "getting things done through others." If this is a fair definition, then it is obvious that a manager has to develop the leadership skills and understanding that will enable him to deal with each subordinate as a unique individual.

Unfortunately, you won't have a "closed circuit" to each employee. Your connection will be a "party line," with all the confusion and static usually found in such a situation. However, if you will keep in mind that your relationship with subordinates is a partnership with all of the privileges and obligations, you'll come through loud and clear — and so will your subordinate.

In a lecture given to Conoco supervisors, Aaron Q. Sartain of Southern Methodist University had this to say: "There are few, if any, people who are satisfied to be simply a cog in a machine, or a name or a number on the payroll. Every person wants to be valued first for what he is, and only secondly for what he does. He believes that he is a creature of dignity and worth, and that those who work with him have genuine regard for him. This is fundamental in dealing with people: They must not be treated as simply a means to an end."

Sharpen Your Memory Here

1. In what terms should you establish goals for your subordinate? For yourself?
2. How can you avoid freezing rigid patterns of thought?
3. Do you like to be your own boss? Do you think those below you do?
4. Can you bring about a new concept of his job to your subordinate?
5. Do you (or should you) be responsible for building responsibility in your subordinate?
6. What different approaches are needed to mechanize a job and to integrate a job?
7. What are some integrated jobs in the petroleum industry?
8. Should you go "all out" in explaining job changes to subordinates?
9. Do you insist that those below you do the job your way?

These People Can Help

[1]*Argyris, Chris, Executive Leadership, Harper and Brothers, New York, 1953.*

[2]*Argyris, Chris, Personality and Organization, Harper and Brothers, New York, 1957.*

[3]*Drucker, Pete F., The Practice of Management, Harper and Brothers, New York, 1954.*

[4]*Leavitt, Harold J., Managerial Psychology, University of Chicago Press, Chicago, 1958.*

[5]*Maier, Norman R. F., Psychology in Industry, Houghton Mifflin Company, Boston, 1955.*

[6]*Michigan, University of, Foundation for Research on Human Behavior, Seminar Reports: "Leadership Patterns and Organizational Effectiveness" and "Training in Human Relations."*

[7]*Selekman, Sylvia and Benjamin, Power and Morality in a Business Society, McGraw-Hill Book Company, Inc., New York, 1956.*

SPECIAL REPORT TO CATERPILLAR OWNERS:

CAT CATERPILLAR

Parts you can trust
Dependable round-the-clock service

CUT MAINTENANCE COSTS...EXTEND EQUIPMENT LIFE BY CHANGING OIL AND FILTERS AS RECOMMENDED

How often should lube oil and filters be changed? The answer is obvious—when the lube oil and filter can no longer do their jobs. But how do you know when that time comes? Can you afford to guess?

Guessing can be costly. The cost of oil changed *more frequently* than necessary adds up to big sums during a work season. *Delayed* oil changes can bring about premature overhauls with more parts replacement costs.

Manufacturer recommendations are based on sound principles. Rapid advancements have been made in perfecting "additive" lube oils that can reduce wear. The familiar ridge left in liners by the piston rings can be practically eliminated by the use of Series III Oils and proper maintenance practices! These oils also allow longer periods between changes.

Full benefit and savings from new oils cannot be had without proper filtering. Caterpillar Engines have an emergency by-pass valve that opens and allows unfiltered oil to circulate if the elements become clogged. And elements become clogged when their dirt-holding capacity is reached. Caterpillar elements have ample dirt-holding capacity to keep the by-pass *closed* over the recommended period.

But aren't the dirt-holding capacities of all makes of filters about the same? To protect the long life reputation of Cat Diesel Engines, Caterpillar continually tests all brands of elements offered for Cat Engines. Below are the *surprising* results, based on tests of filters purchased on the open market during 1957 and 1958. During these tests commercial test dust was gradually added to clean oil until each filter clogged and the emergency by-pass valve opened. The amount of dirt added is recorded in the "Sediment Index" column.

HOW CAT FILTERS COMPARE WITH OTHER BRANDS

Brand	Filtering Area (Square Inches)	Sediment Index (In Grams)	Comparison
CATERPILLAR	1450	75	Used as basis for recommended oil and element change periods.
BRAND A	1450	13	Cat element lasted nearly 6 times longer.
BRAND B	1170	22	Cat element lasted 3 times longer.
BRAND C	1000	34	Cat element lasted more than twice as long.
BRAND D	Not measurable	No oil flow	Opens by-pass immediately even when new.
BRAND E	1450	26	Cat element lasted nearly 3 times longer.

SERVICE TIP:

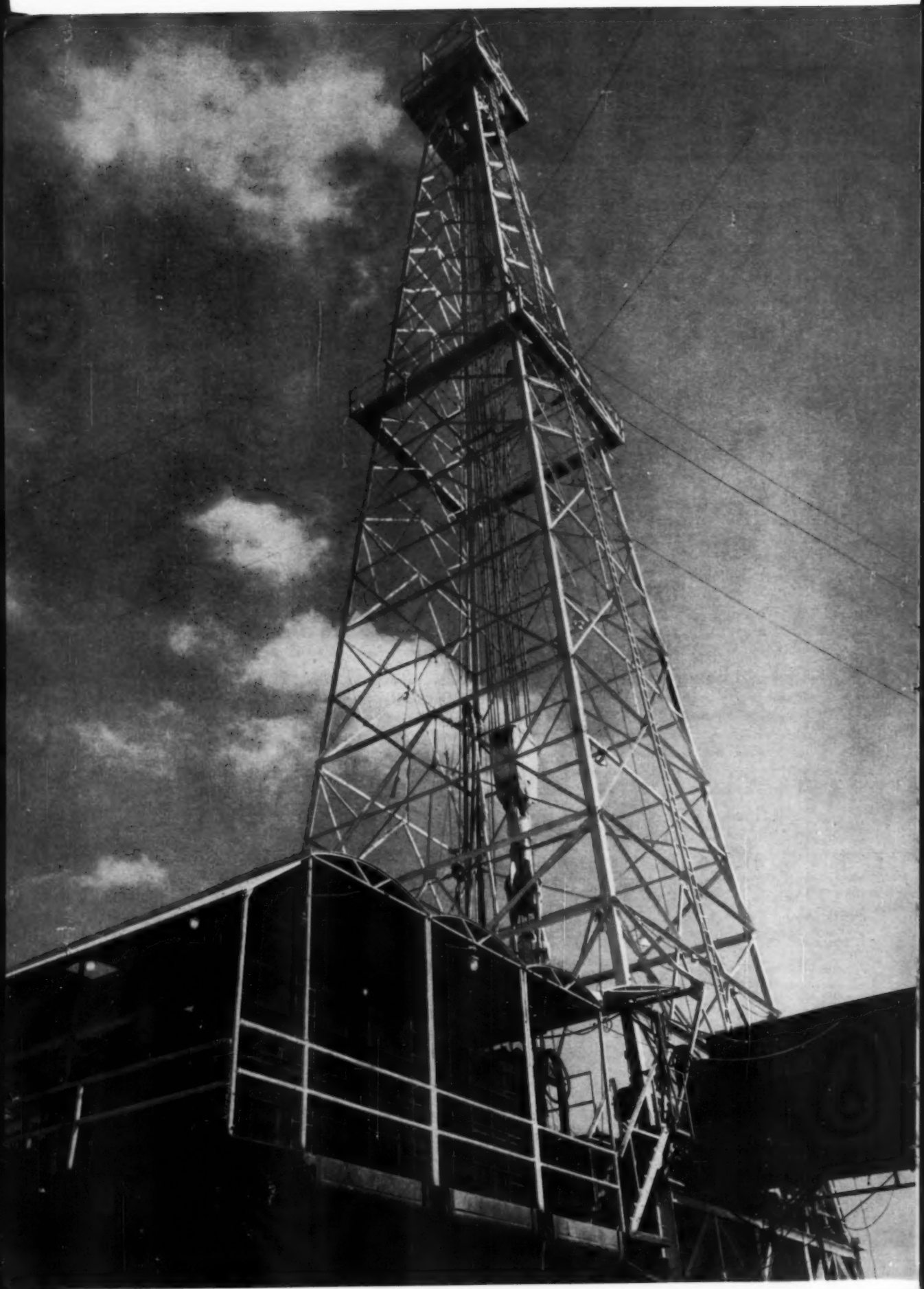
Get your copy of "Crankcase Lubricating Oil Change Recommendations," Form 32421-1W, from your Caterpillar Dealer right away. Keep pace with the new lube oil developments.

Your Caterpillar Dealer has the complete story on the advantages of changing lube oil and filters as recommended. Ask him to figure your annual engine oil costs for you, and see how much you can save. See him today!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.



USS Tiger Brand—America's No. 1 Wire Rope

helps drill world's second deepest well to 24,004 feet

The world's second deepest well is now the Shell Oil Company's 5 Rumberger in the Elk City field of western Oklahoma. It is Oklahoma's *deepest* well, and a triumph for Helmerich & Payne, Tulsa drilling contractors.

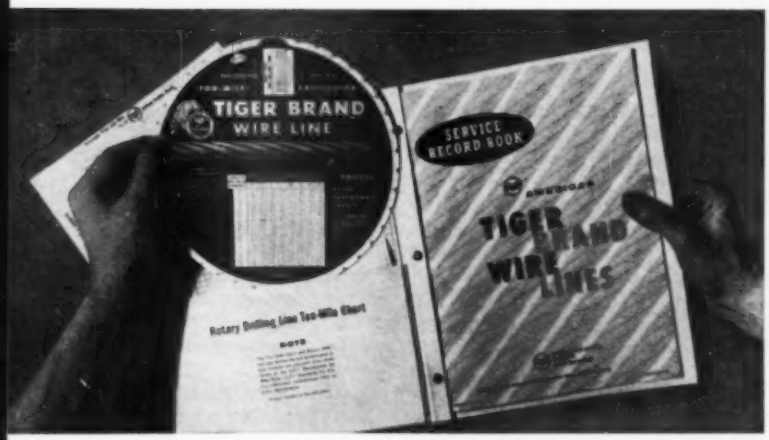
Besides the spectacular depth of 24,004 feet, Helmerich & Payne cite a far more unusual story. In the words of Lacy Wall, veteran tool pusher, "This has been the smoothest, most trouble-free well we have ever drilled in my 40 years of experience." Some of the freedom from trouble comes from the fact that Helmerich & Payne make it a habit to get their full dollar's worth when buying drilling lines. They are sold on the quality of USS Tiger Brand Wire Rope. This rig was equipped with 5,000 feet of 1⅜", 6 x 19 Seale Monitor Excellay IWRC Rotary Line.

Why Tiger Brand is your best buy

1. It is made by a company that maintains the most complete wire rope research and manufacturing facilities in the country.
2. It is designed by one of the country's most capable staffs of wire rope engineers. It is serviced by thoroughly experienced field representatives always ready with their assistance.
3. Every type of Tiger Brand Wire Rope is designed for specific applications. *You* get the *right* rope for the job.
4. It is made by one company, U. S. Steel, and every step of production, from ore to finished product, is carefully controlled and supervised to guarantee *one* high standard of quality.
5. Tiger Brand Wire Rope is manufactured by the largest single producer in the country.

USS and Tiger Brand are registered trademarks

How to keep ton-mile records easily and accurately



Free Ton-Mile Calculator and Rotary Drilling Line Service Record Book. Set the dial of this calculator for the correct drilling depth and drill pipe size and you can tell at a glance the number of ton-miles involved in each round trip down and back up out of the hole.

New Tiger Brand Wire Rope Oil Field Catalog. Shows all the latest wire rope constructions; how to select the right rope for the job; and how to take care of the rope to get longer life.

◀ **Helmerich & Payne's** rig No. 47 drilling about five miles south of Elk City, Oklahoma, set a new depth record for Oklahoma at 24,004 feet.

American Steel & Wire
Division of
United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, Distributors Abroad

American Steel & Wire
614 Superior Avenue, N. W., Room 929
Cleveland 13, Ohio

☐ *Rush me your free Tiger Brand Service Record Book with ton-mile calculator*

☐ *Send new Tiger Brand Wire Rope Oil Field Catalog*

NAME _____

FIRM _____

ADDRESS _____

CITY & STATE _____

THE DANGER OF POLITICAL INACTIVITY

Book by General Electric's Political Affairs Manager provides reliable guide to politics for business and industry

"DON'T GET INTO POLITICS. Remember the Dixon-Yates case? The antibusiness liberals went out for the kill on that. They made a perfectly honest deal look black because it dared to put a limit on TVA. Don't run into that propaganda machine or you're dead."

So speak the timid and the expediential. But practical and far-seeing management was concerned about the future of business and country. Some decided it was dangerous not to face the politicians, labor union leaders, and journalists who whirled in a tornado of socialistic power that threatened destruction of the successful capitalistic system.

Perhaps the first of these was General Electric and because GE named J. J. Wuerthner, Jr., manager of Public Affairs, he has had unusual opportunity to plan and evaluate the private company's place in political activity.

In his new book, "The Businessman's Guide to Practical Politics," (published by Henry Regnery Company, Chicago, Illinois, price, $3.75) he provides a handbook that all management people need whether their particular company has a policy on the matter or not.

Wuerthner says: "The first broad trend underlying the new challenge to business evolves from the basic fact that the days when business could be judged solely by the black or red ink on the profit and loss ledger are behind us because nowadays the operating statement is increasingly dependent on government decisions and political actions. There is practically no major issue today at the national or state level which doesn't have a direct bearing on the operation of business and industry."

He goes on to explain: "The tentacles of government supervision and intervention by rules, laws, agencies, and bodies extend from the mining or production of raw material through the basic processing stage, engineering, and design to the production and ultimate sale of the commodity or final packaged material."

This observation can be appreciated by the petroleum industry. As Jake L. Hamon said in a recent speech, we are the only industry that goes from the search for natural resources and their production to product sales.

The Businessman's Guide points out that increasing government involvement in private enterprise means lessening of management's ability to make decisions. For instance, we have the FTC prohibiting lowering prices in certain instances and on the other hand the new mandatory imports bill holds a threat of controls over a price increase. Is this competitive enterprise?

The author has made a study of the labor union political movement, which gives both devices to watch and ideas that management might well copy to good effect. There is little question that in politics labor unionism has far outrun business and industry organizations. Perhaps this is due in large part to reluctance to change tactics — to mistake pompousness for dignity; to give money without support.

The GE manager of Public Affairs lays the political facts of life on the line. He tells you what you can do, what you should do and why.

He organized the Syracuse Seminars on Practical Politics[1] for any companies that wanted to join. It was backed by the Manufacturers Association of Syracuse, New York.

Enough information is supplied to work up your own. This is a practical textbook that can be put to use. It is not a recital of defensive measures — although the reasons for defense are set forth.

One suggestion of Wuerthner is that corporations should have political specialists in management. Recently some oil companies have named men to this kind of position. In the past, petroleum management has had political experts in strategic posts but these men have sometimes lacked the authority to be effective. There was an aura of secrecy or a tinge of behind-the-scenes manipulator about the job that made casual observers suspicious. They were credited with more power than they ever attained. The tales of the "oil lobby" have grown out of this group of representatives whose weapons have been pitted against more powerful anti-oil forces.

The author explains the work of Public Affairs Counsellors, Inc. which conducts seminars of applied citizenship. One of the partners, Joseph J. Eley, wrote *The Petroleum Engineer* article "How to Become Politically Effective.*"

Wuerthner concludes that "The need, then, is for management philosophy which seeks out approaching trends in government and political fields and then devises programs in which the corporation and its personnel can participate actively in helping to mold the factors of such situations through economic, ideological, political, and common-sense communication and action."

If you think this book may be partisan, please note that James A. Farley and Leonard W. Hall both recommend it.

* * *

[1]Received only award in the nation given to a corporation in 1957 by American Heritage Foundation.

*The Petroleum Engineer, February, 1959, Page E-1.

SAVE maintenance

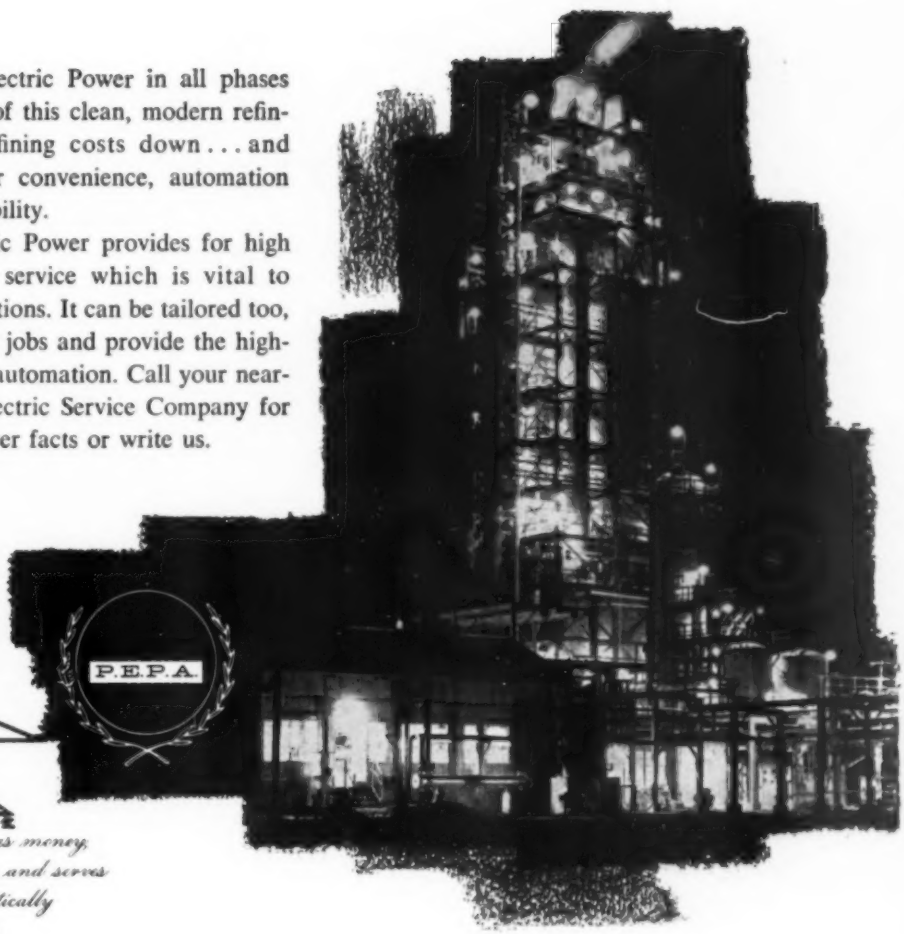
SAVE manpower

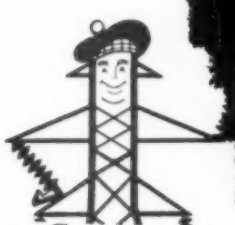
SAVE with Electric Power

SAVE money

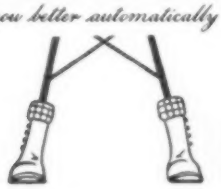
Purchased Electric Power in all phases of operation of this clean, modern refinery holds refining costs down . . . and means greater convenience, automation and dependability.

Utility Electric Power provides for high continuity of service which is vital to refining operations. It can be tailored too, for individual jobs and provide the highest degree of automation. Call your nearest Utility Electric Service Company for complete power facts or write us.





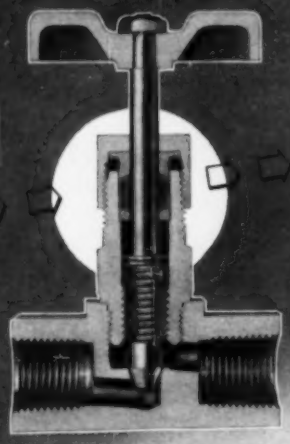
Electric Power . . . saves money, manpower, maintenance and serves you better automatically

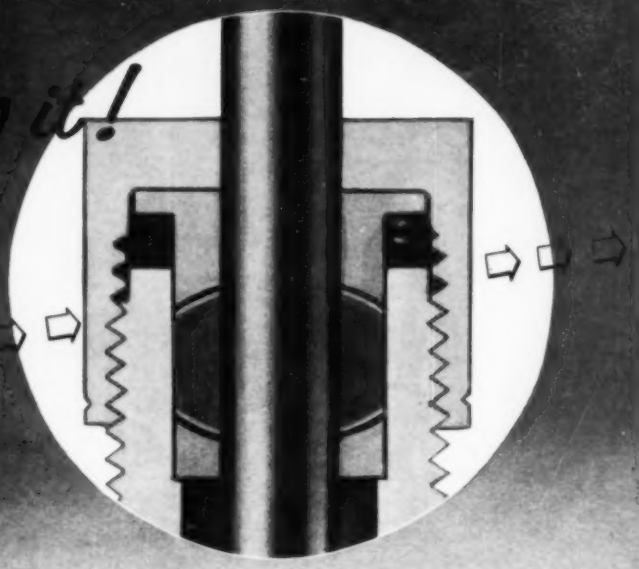


Petroleum Electric Power Association

P.O. BOX 35006, DALLAS 35, TEXAS

Marsh has it!





The Marpak Packing System

—*now with fabulous*

"TEFLON" PACKING

An outstanding feature of the Marsh Needle Valve has been the Marpak Packing System. This unique method of obtaining a tight, but non-binding seal is one of the important reasons for the ability of Marsh Valves to give precision regulation at any pressure up to 10,000 psi.

Now the Marpak system has been made still better by the use of today's miracle material—"Teflon." You probably know of the almost incredible toughness, resilience and non-adhesive properties of Teflon—properties that are unimpaired by the most powerful of solvents, acids, or alkalies, even at temperatures up to 500° F.! As a result of incorporating "Teflon" packing, Marsh Stainless Steel Needle Valves are now

Guaranteed for any pressure up to 10,000 psi at any temperature up to 500° F.

In other makes of valves permissable temperature *decreases* as pressure *increases*—but not with Marsh.

Teflon packing is one more addition to the list of features that are combined only in Marsh Stainless Steel Needle Throttling Valves. Note the list opposite...ask for bulletin.

Available in

MARSH

416 Stainless Steel
Needle Throttling Valves

- **Body and stem guide machined from bar stainless steel stock**
- **Valve Stem hardened stainless**
- **Fine stem threads for extra strength and precision throttling**
- **Deeper inlet and outlet chambers**
- **Bodies made in accordance with MSS regulations**
- **Packing "Marpak" system incorporating "Teflon" as described opposite**

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corp.*, **Dept. M Skokie, Ill.**
Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Laugh with Barney

The old fashion girl took two drinks and was out like a light; the modern girl takes two drinks and out goes the light.

"I am sorry," said the dentist, "but you cannot have an appointment with me this afternoon. I have eighteen cavities to fill." And he picked up his golf bag and went out.

She laughed when I sat down to play. How did I know she was ticklish?

Zippers are the undoing of the modern girl.

When Suzy the office rattlebrain was asked: "What would you like to have for reading material if you were marooned on an island, she replied: "A tatooed sailor."

After delivering Mrs. Brown's 10th child, the doctor called the husband aside.

"Next time you feel like propogating," he said, "ask yourself if you can support another child."

"Doc," said Brown, "When I feel like propagatin' I feel like I could support the whole state of Georgia."

I like blondes platinum
With some fatinum
For the pleasure of patinum.

Overheard on the radio:
Edna: "John, Darling, I love you."
John: "Run to me, dearest, and kiss me."
Edna: "No, John dear, I will walk to you and kiss you."
John: "Dearest, if you really love me, you will run to me."
Announcer: "And so, listeners, tune in again tomorrow to find out whether Edna runs or walks to her John."

The blonde chorus girl sailed into her apartment in the wee hours looking tired and disheveled. "I went out with a Chicago millionaire," she said to her roommate, "and he gave me $700."

"Wow," snickered her roommate. "That's the first time I ever heard of a $698 tip!"

A salesman was explaining to his buddy the reason for his sudden affluence.

"I sell ladies stockings. Sometimes if the woman of the house is really interested, I put them on for her," he said.

"You must sell plenty that way," said the friend.

"No, not really," said the salesman. "My leg looks lousy in a woman's stocking."

Customer: "Have you any good aftershave lotion?"
Clerk: "Yes. Here's a little number that drives the girls crazy. It smells like a new car."

Figures don't lie, but girdles condense the truth.

Father, to small boy dragging top half of Bikini bathing suit along the beach: "Now show Daddy exactly where you found it . . ."

"I always wanted to know how long girls should be courted."
"Same as short ones."

To get his Wealth he spent his Health
And then, with might and main,
He turned around and spent his Wealth
To get his Health again.

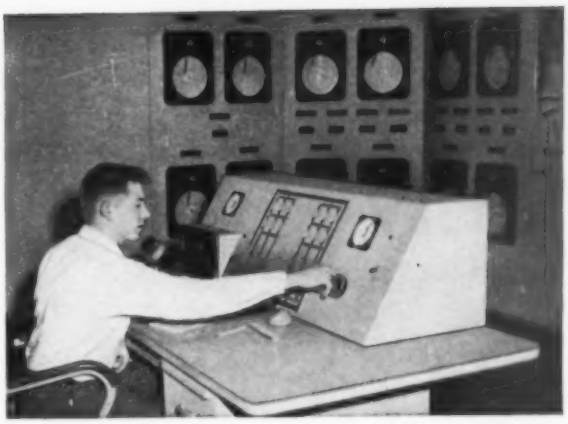
Remember the poem used in the March issue:

"If there's nothing worse than a waffle that's cold,
Or mashed potatoes five days old;
It's suddenly meeting an old fat hen
Whom you loved in school in 1910."

Well, Barney received an answering poem from a pert young lady in California that puts the smile on the other foot.

"If there's nothing worse than warmed over stew,
Or cleaning the dishes after everyone's through;
It's meeting the man with a shining bald pate,
Your 'Heart-throb' in school in 'twenty-eight'!"

Thanks, Ann.



ONE man does the work of many...with AMERICAN® telemetering-telecounting equipment

In the largest gathering fields, along the pipelines, in large and small distribution systems, American telemetering and telecounting equipment substantially reduces personnel required for transmission of meter readings. From a central dispatching station, one man instantly obtains accurate flow and pressure readings at remote points and adjusts for load demands with remote-set controllers.

Your American representative can help you benefit by telemetering and telecounting all or any part of your system—large or small.

For Base Volume Indexes— American Telecounters accurately transmit Base Volume Index indications of gas quantities computed to base temperature and base pressure conditions, to remote locations.

For further information consult your American Meter representative.

AMERICAN® METER COMPANY
INCORPORATED (ESTABLISHED 1836)

GENERAL SALES OFFICE: Philadelphia 16, Pennsylvania • Albany Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago Dallas • Denver • Erie • Houston • Kansas City • Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco • Seattle Tulsa • Wynnewood' IN CANADA: Canadian Meter Company, Ltd., Milton, Ontario • Calgary • Edmonton • Montreal • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters Instruments • Reliance Regulators • Apparatus • Valves

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Exterior view of Utica Station.

The three compact 6-cylinder Cooper-Bessemer GMVC Compressors are rated 1000 hp at 300 rpm. Two have been in service since 1957. One was added in 1959.

Victor G. Fulkerson, *Head Engineer, Utica Station,*
New York State Natural Gas Corporation, explains...

How the new Utica Station meets growing demands with Cooper-Bessemer Compressors

"Our Utica Station was built in 1957 to boost gas pressure for the mounting demands of the Albany-Schenectady area. It housed two 1000 hp Cooper-Bessemer Series-Turbocharged V-Angle Compressors. Then, a demand for 20 million cubic feet more gas daily required the addition of a third unit of the same type and size this year (1959).

"Averaging about 85 million cubic feet per 24 hours, the station has pumped peak loads of as much as 140 million cubic feet. Entering the station at 400-700 psi, the gas is discharged at 600-900 psi."

FACTS ABOUT COOPER-BESSEMER SERIES-TURBOCHARGED V-ANGLE COMPRESSORS

Peak Load—Plus Capacity. Plenty of reserve power, always ready for those unexpected extra demands, provides a big economy advantage.

Low Fuel Consumption. Guaranteed not to exceed 7200 Btu/bhp-hr at full load!

Less Housing Cost. Compact V-angle design, combined with 40% power increase of series turbocharging, means today's highest power-to-space ratio, with no increase in piping or cooling requirements.

Minimum Oil Consumption. Cooper-Bessemer "cocktail-shaker" piston cooling, precision-honed cylinders, and advanced piston and ring design, combined with highly efficient, full-flow filtration, results in exceptional lube oil economy.

Low Maintenance. Many factors contribute to records of trouble-free performance—the simplicity of V-angle 2-cycle design, fewer moving parts, accessibility, conservative ratings, and, extremely significant, vibrationless operation.

Write For Bulletins. Complete details on Cooper-Bessemer V-Angle Compressors are given in bulletins... free on request. Call our nearest office to help you plan new facilities.

BRANCH OFFICES: Grove City • New York • Washington • Gloucester • Chicago • Minneapolis
St. Louis • Kansas City • Tulsa • New Orleans • Shreveport • Houston • Greggton • Dallas • Odessa
Pampa • Casper • Seattle • San Francisco • Los Angeles

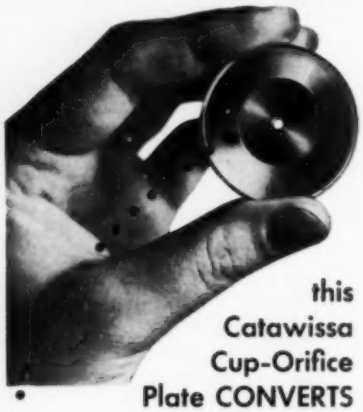
SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd.... Edmonton • Calgary • Toronto • Halifax
C-B Southern, Inc.... Houston
Cooper-Bessemer International Corporation... New York • Caracas • Mexico City
Cooper-Bessemer, S.A.... Zurich, Switzerland

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

here's real **ECONOMY...**
time-saving **SIMPLICITY...**
and sure-fire **DEPENDABILITY**
for metering, measuring, controlling any piped material!



this Catawissa Cup-Orifice Plate CONVERTS any standard Catawissa Union into a ***GASKETLESS*** **ORIFICE UNION**

ELIMINATES the necessity of expensive gaskets...the uncertainty of what type gaskets are needed for specific temperature and pressure requirements... fumbling with extra parts!!!

Orifice Union problems of the past are gone forever! Stainless or carbon steel cup-orifice plate fits easily, quickly, securely to form a good, tight, leakproof seal. Temperature and pressure requirements are restricted only by the rating of the union itself (3000-lb. service, 9000-lb. test)!

Just specify "Catawissa Cup-Orifice Plates" or "Catawissa Cup-Orifice Unions" at your favorite supply store—or write for catalog and complete information.

CATAWISSA VALVE & FITTINGS CO.
CATAWISSA • PENNSYLVANIA

Management Personals

▸ Re-elected to 3-year terms as directors of Texas Pacific Coal and Oil Company were **H. B. Fuqua,** board chairman; **W. R. Berger,** Fort Worth geologist; **Sid W. Richardson,** Fort Worth oil and gas producer, and **A. H. Rowan,** Rowan Drilling Company, Fort Worth. Also Fuqua was re-elected chairman and chief executive

R. W. Hines

J. W. Yarbro

officer, **Eugene T. Adair,** president. **Hamilton Rogers,** executive vice president, and **R. I. Dickey,** vice president, exploration.

Rudolph Seibel, with Texas Pacific 40 years, retired as vice president, treasurer and secretary. **J. R. Teague,** 30-year veteran, stepped down as vice president, production. **R. W. Hines,** former production manager, was elected vice president, production, and **J. W. Yarbro,** vice president,

J. I. Norman

H. O. Anderson

financial. **J. I. Norman** was named secretary and assistant treasurer, and **Harry O. Anderson** treasurer and assistant secretary. **H. S. Vacker** also was named an assistant secretary. **D. A. Bonney** succeeds Hines as manager of production. **Miles Hart** of the legal staff was named general attorney.

▸ **S. C. Sandusky,** formerly petroleum engineer and supervisor of reservoir engineering in the Ohio Oil Company Shreveport, Louisiana, production division, was appointed supervisor of the engineering and contracts department of the natural gas division at the company's general offices in Findlay, Ohio. He replaces **F. C. Aldrich** who advanced to manager of the Sidney, Nebraska, production district. **R. D. Ross,** district reservoir engineer at Phoenix Lake, Louisiana, replaces Sandusky.

▸ **R. C. Brown,** Calgary, Alberta, has resigned as president and director of Hudson's Bay Oil and Gas Company Ltd. **G. T. Pearson,** Fort Worth, Texas, southwestern regional general manager for Continental Oil Company of Delaware, will succeed him as president and director.

Brown becomes a vice president and a director of Continental. His headquarters will be in London, England, and he will be the foreign representative.

▸ **Bert E. Sager** joined Dellson Drilling Company as a vice president. Sager is known throughout the Rocky Mountain area, having spent a number of years with Brinkerhoff Drilling Company and with Dunbar Drilling Company.

▸ **R. D. Smith,** assistant to the president an executive representative for Union Oil Company of California in Great Falls (Montana), retired to become a consultant for the company.

▸ **R. C. Frederick** was appointed senior vice president of Texas Natural Gasoline Corporation. Prior to joining Texas Natural, he was associated with Gulf Oil as coordinator for gas and gas liquids in the production department, with an interval of 6 months in 1955 when he served as vice president in charge of gas purchases and gas sales for the Pacific Northwest Pipe Line.

▸ **Edward P. Fischer** was elected treasurer of Socony Mobil Oil Company, Inc. He succeeds **Victor B. Geibel,** who retires. Fischer joined the company in 1925 and has been an assistant treasurer since 1946.

Six new vice presidents of Phillips Petroleum Company were elected by the board of directors. Formerly managers of their respective departments, the new vice presidents are, left to right, Harry G. Fair, supply and transportation department; R. B. Stewart, natural gas department; G. W. McCullough, natural gasoline department; L. E. Fitzjarrald, production department; E. H. Lyon, sales department; and C. C. Tate, refining department.

▸ **Fred A. Davies,** chairman of the board of directors of the Arabian American Oil Company, retired in May. Board chairman since 1952, Davies also was Aramco's chief executive officer until 1958, when President **Norman Hardy** succeeded him in that position.

Previously Davies had been Aramco vice president in charge of exploration and production and executive vice president. In addition, Davies is a director of the Trans-Arabian Pipe Line Company.

▸ **Louis J. Brunel,** vice president and general manager of Bishop Oil Company since 1927, was elected president. **Wm. Wallace Mein Jr.,** who has served as company president since 1953 and chairman of the board since 1956, will continue as chairman of the board. All other officers were re-elected, and members of the board also re-elected.

▸ **John S. Wertz,** chairman of the board of directors, Vickers Petroleum Company, Inc., Wichita, has retired. A 38-year veteran with the company, Wertz served Vickers in several executive capacities beginning in 1921 as secretary-treasurer; in 1947 as president; and in 1952, assumed the post of chairman of the board.

Peter A. Blasco, former general manager of refining, Aurora Gasoline Company, Detroit, Michigan, was named vice president, manufacturing, Vickers Petroleum. Blasco succeeds **A. M. "Bob" Schrepfer,** retired.

▸ **Quincy V. Tuma** was promoted to chief safety engineer for Texaco Inc. He succeeds **C. A. Miller,** who retired. **Kraus Earhart,** staff assistant, was named to replace Tuma as safety supervisor. Both will have headquarters in Houston, Texas.

▸ **Robert T. Parrish** was appointed head of the employee relations group of Creole Petroleum Corporation's New York offices. Parrish replaces **George T. Culp** who is returning to Venezuela as industrial relations coordinator in Creole's office in Caracas.

▸ **H. L. Burns** was promoted to manager and **Jolly D. Backer** advanced to assistant manager of the Mexico and Central America offices of the foreign sales and development department Phillips Petroleum Company. **Harry C. Jordan** was promoted to manager of the Argentina office with headquarters in Buenos Aires, Argentina.

Burns was a senior sales engineer in Mexico City; Backer was in charge of sales in Venezuela, and Jordan was in the sales department as district manager for fertilizer sales in Mexico.

▸ **Winfield Givens** was elected executive vice president and **H. J. Weeks** as vice president of each of Sun Oil Company's 8 foreign production subsidiaries. Givens formerly was vice president of 6 subsidiaries, as well as foreign representative for Sun's foreign operations department. In his new post, his responsibilities will be in governmental contacts and public relations. He continues as manager of land department. Weeks remains as geological counselor for the parent company's foreign operations department. **P. W. McFarland** was elected vice president and general manager of two new subsidiaries, Argentine Sun Oil Company and Bolivian Sun Oil Company. He will continue to hold with all other foreign production subsidiaries except Pakistan Sun. **John D. LaTouche** was re-elected vice president and general manager of Pakistan Sun.

▸ **J. Howell Turner,** general manager of employee and public relations of Standard Oil Company (Indiana), was elected a member of the company's board of directors. He replaces as a director **Dr. William J. McGill,** retired as general manager of employee and public relations after more than 34 years' service.

▸ **Sol Smith,** consultant petroleum and natural gas engineer, Austin, Texas, was elected to the board of directors, Seminole Oil and Gas Corporation, in charge of technical operations.

▸ **George A. Birrell** was appointed general counsel of Mobil International Oil Company, the international operating division of Socony Mobil Oil Co., Inc. He succeeds **W. L. King,** who is retiring after 20 years' service with Socony Mobil.

▸ **Dr. Joseph E. Pogue,** a director and petroleum consultant of Gulf Oil Corporation since 1949, has resigned both positions in order to devote a greater portion of his time to personal affairs. He is succeeded as a director by **Frank R. Denton,** who is vice chairman, a director and chief executive officer of the Mellon National Bank and Trust Company.

DEATHS

▸ **E. N. Koonsman,** 66, well-known "old timer" of the oil industry, and representative of Pittsburgh-Des Moines Steel Company, died recently in Veteran's Hospital in Dallas following a short illness. Burial services were held in Lafayette, Indiana.

▸ **Harry A. Miller,** assistant controller and manager of the production and pipeline accounting division of Ohio Oil Company, died May 6. He had 28 years of service and was 64.

Florex—for adsorption

Recognized throughout the world as superior to all other natural clays used in adsorption processes, Florex is particularly effective in the adsorptive refining, decolorization, clarification and neutralization of mineral, vegetable, and animal oils, fats and waxes. Florex is also effectively used for sweetening light distillates, dehydration, desulfurization and polymerization.

Florex is prepared from carefully selected natural Florida Fullers Earth by a special processing including high-pressure extrusion, which greatly improves adsorptive efficiency and capacity.

Standard particle sizes are herein reproduced and include meshes from 2/4 to 200/ up. Special meshes are also available. Florex is packaged to fulfill customer's requirements with the Fifty (50) pound non-returnable paper bag the minimum quantity.

For further information use free request coupon below.

FLOREX MESH—ACTUAL SIZE

FLORIDIN COMPANY

• Adsorbents
• Desiccants
• Diluents

DEPT. D P. O. BOX 989
TALLAHASSEE, FLORIDA

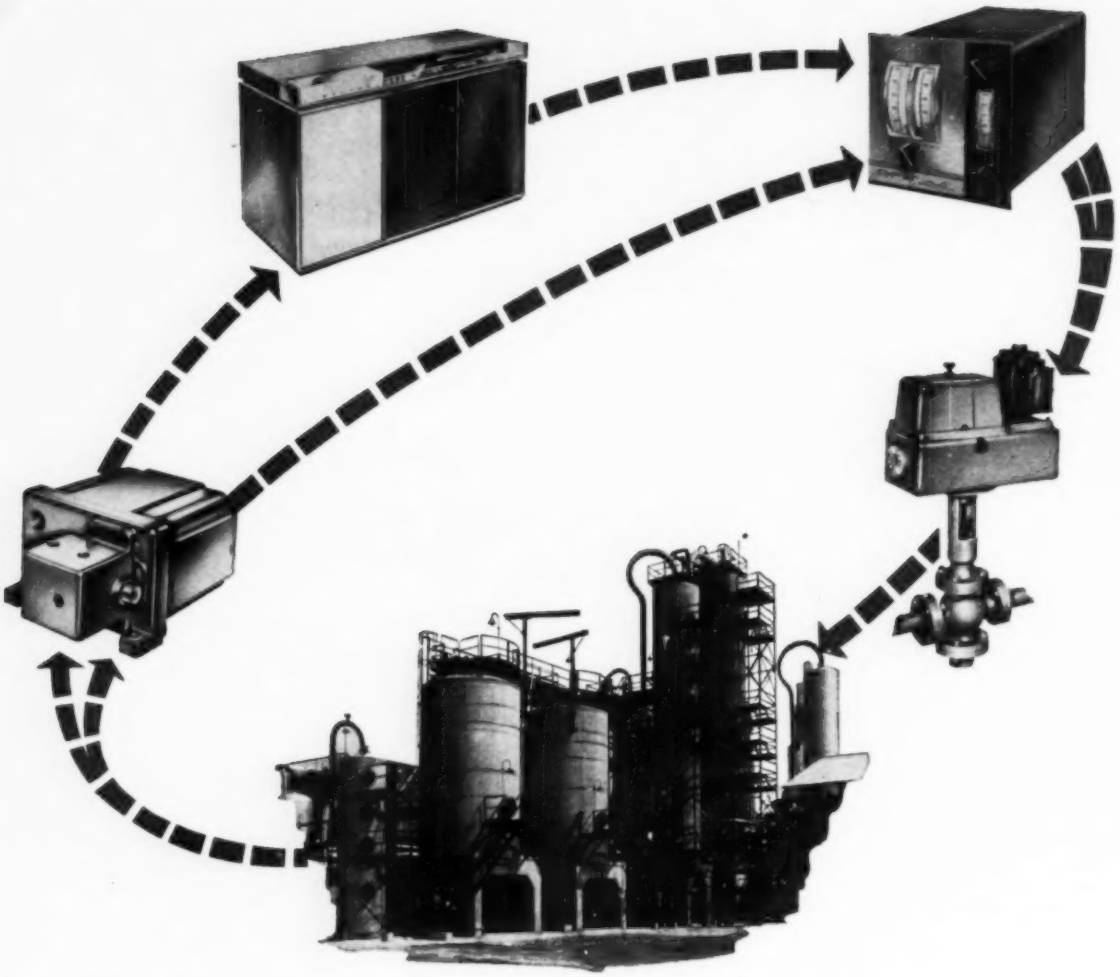
Please send literature ☐ and sample ☐ of Florex
(Be sure to indicate mesh size_____)

Name_____

Address_____

City_____

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



See it IN ACTION!

CLOSED-LOOP COMPUTERIZED CONTROL

In actual operation!

For 1959, this is the big news in automatic controls for the petroleum industry—closed-loop process control systems incorporating digital computers!

This most modern concept of automatic control is a down-to-earth reality – right here and right now. You can see it in operation . . . actually guide its performance . . . in the GPE Controls booth at the 5th World Petroleum Congress.

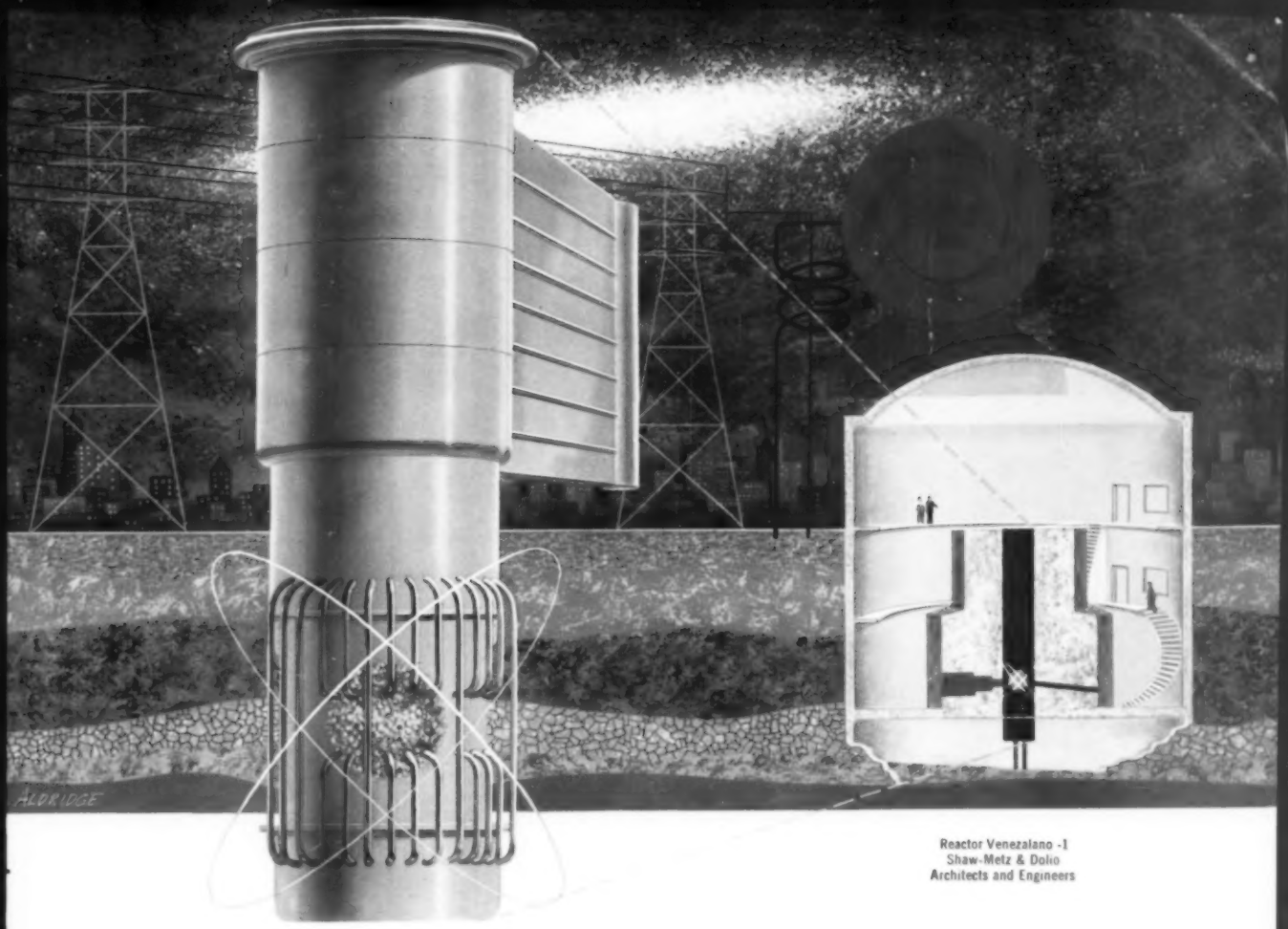
And you can realize its benefits on your own processes—today—because GPE Controls, Inc. supplies closed-loop system components manufactured by its own divisions and designed to operate together. Visit Booth 376 or write for full information.

GPE Controls | A GENERAL PRECISION COMPANY

Be sure to visit Booth 376

GPE Controls, Inc. (formerly Askania Regulator Company)
240 East Ontario Street • Chicago 11, Illinois

A Subsidiary of GENERAL PRECISION EQUIPMENT CORPORATION



Reactor Venezalano -1
Shaw-Metz & Dolio
Architects and Engineers

ENGINEERING

FABRICATION

FIELD ERECTION

Peaceful atoms at work

A bright spot in the future of the peaceful atom is the type of nuclear power plant now appearing in this country and others.

Solar Chicago fabricated the pool liner for such a power plant recently. The pool liner—that's the vertical cylinder shown above—is used to contain radioactive material.

Whether it's a fabricated structure to help harness the atom, a pressure vessel for chemical or petroleum processing, or a new type of vessel to improve a brewery process, you can look to Solar Chicago for a superior design and fabricating job.

The next time you need process equipment of any type, give us a call. We'll meet the most rigid requirements for quality—the toughest delivery schedule.

Write today for our brochure

USI Solar Chicago DIV. U.S. INDUSTRIES, INC.

6400 W. 66th St., CHICAGO 38, ILL.

Telephone POrtsmouth 7-8900

FORMERLY CHICAGO STEEL TANK CO.

OFFICES IN:

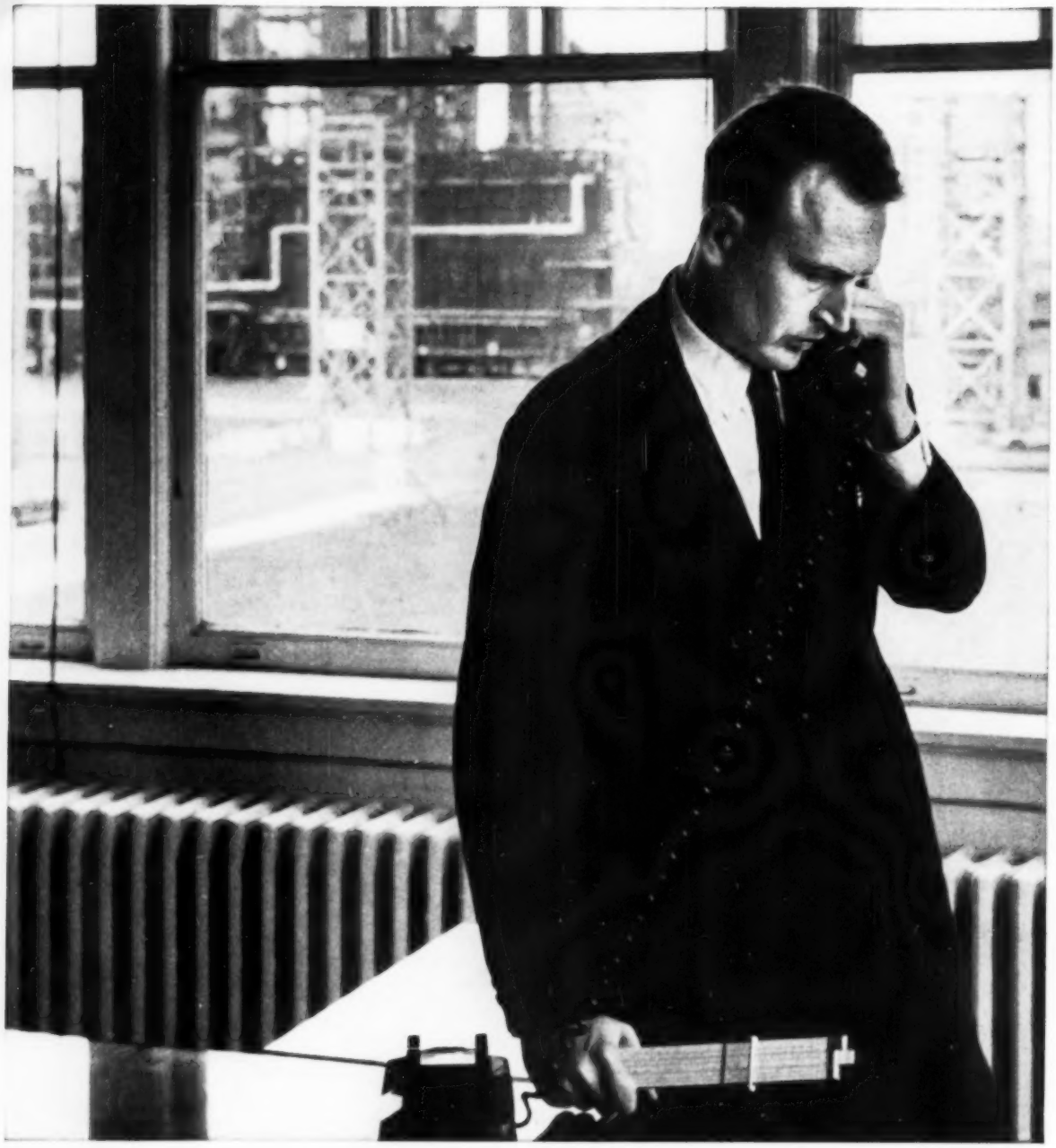
Jacksonville Beach, Florida
R. W. Fowler & Assoc. Inc.
P. O. Box 101
Cherry 6-2477

Tulsa, Oklahoma
Mr. R. J. Dunham
716 Wright Bldg.
Diamond 3-8165

New York
Solar Chicago
274 Madison Avenue
Murray Hill 7-9298

Louisville, Kentucky
Solar Chicago
2416 Frankfort Ave.
Twinbrook 5-5389

Los Angeles, California
R. D. Morrison
1324 Wilshire Blvd.
Hubbard 3-4369



"Productivity is the end result of four factors working together effectively: labor, management, capital, and technology. No one or two can produce alone – all four are needed. And a reasonable balance among all four must be achieved constantly. To maintain this balance in our complex world today requires more knowledge, more understanding, more creativeness and more objective thinking on the part of more people. Education should lead towards this result, and the broadly trained scientific college graduate is certainly one of the key figures in the picture."

M. J. Rathbone, President, Standard Oil Company (New Jersey)

Standard Oil Company (New Jersey)
and affiliated companies

Esso

ALLEN-BRADLEY | Cutting Costs in the Chemical Industry

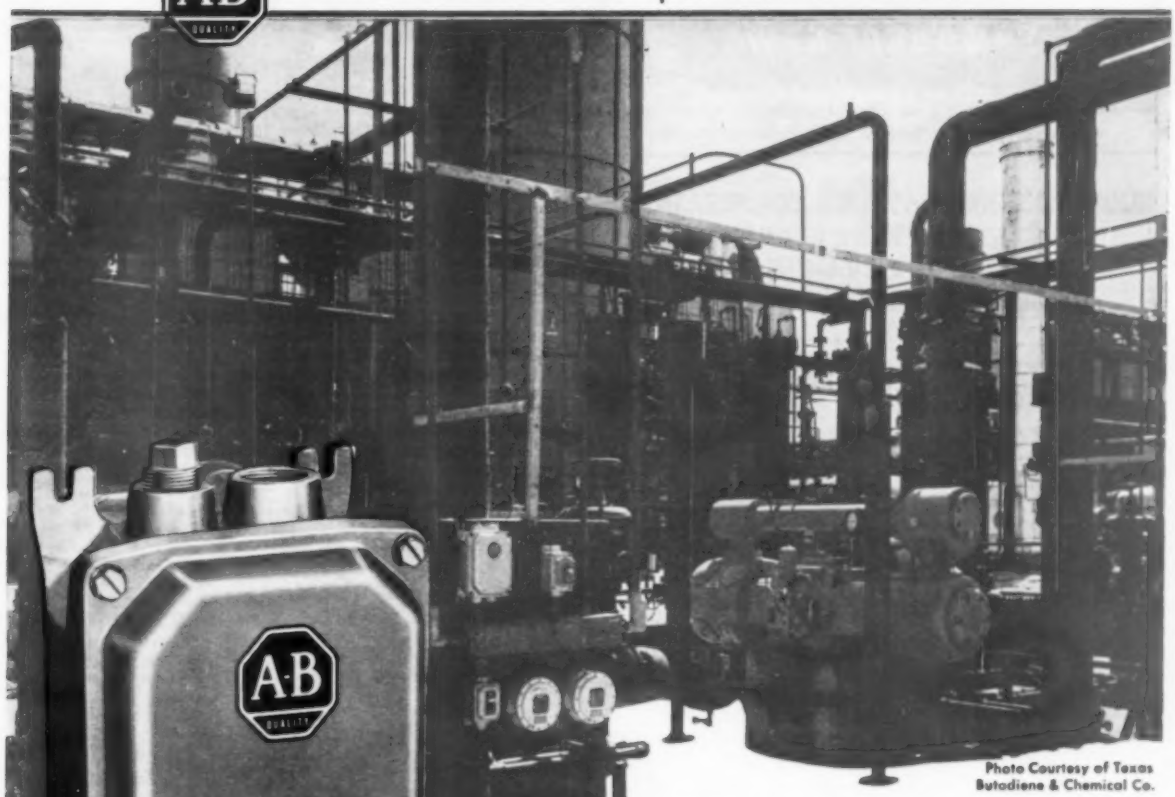


Photo Courtesy of Texas Butadiene & Chemical Co.

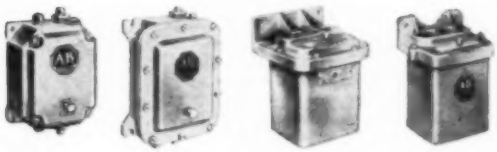
This Motor Starter is built to be forgotten!

Even routine inspection is kept to an absolute minimum with Allen-Bradley motor starters . . . an especially important saving when your installation requires bolted covers, as used with watertight and explosion-proof enclosures.

It's the simple contact mechanism—with only ONE moving part—that enables Allen-Bradley solenoid starters to operate over long periods without attention. With no bearings to corrode or stick . . . no flexible jumpers to break . . . you are assured *millions* of trouble free operations. In addition, there are double break, silver alloy contacts that never need servicing of any kind. And permanently accurate thermal overload relays protect motors against burnout, irrespective of time or atmospheric conditions.

Specify Allen-Bradley quality controls for *all* your installations . . . and you'll save on maintenance.

Bulletin 709 Size 1 Solenoid Starter in NEMA Type 4 watertight enclosure



NEMA 9 For Hazardous Dust

NEMA 7 For Hazardous Gas Locations

NEMA 8 For Corrosive Hazardous Gas

NEMA 11 Corrosion-proof

Allen-Bradley Bulletin 709 across-the-line solenoid starters are made in eight sizes with maximum ratings to 300 hp, 220 volts; 600 hp, 440-550 volts.

ALLEN-BRADLEY CO.
MOTOR CONTROL
QUALITY

Allen-Bradley Co., 214 W. Greenfield Ave. Milwaukee 4, Wis.

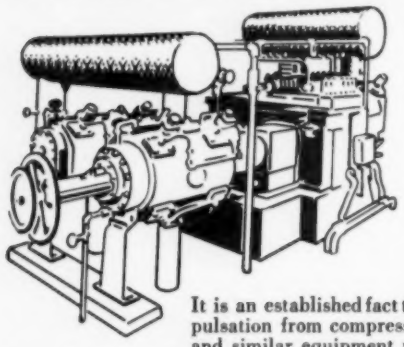
In Canada: Allen-Bradley Canada Ltd. Galt, Ont.

BURGESS-MANNING

SNUBBER NEWS

Dedicated to the Elimination of Pulsation and Intake and Exhaust Noise

HOUSTON TEXAS GAS & OIL CORPORATION'S COMPRESSOR PIPING GUARANTEED TO BE KEPT VIBRATION-FREE BY BURGESS-MANNING SNUBBERS



It is an established fact that pulsation from compressors and similar equipment produces vibration that causes rapid deterioration of equipment, skyrockets maintenance costs and often threatens the very structures housing the equipment.

Recognizing this, the builders of the Houston Texas Gas and Oil Corporation's natural gas pipe line to Florida are installing 48 Burgess-Manning Snubbers of eight different designs on the compressors at the four stations along the line.

Burgess-Manning Company is guaranteeing the successful operation of all compressor piping and related inline equipment without excessive or damaging pulsation.

Successful accomplishment of guaranteed results has become a foregone conclusion to Burgess-Manning customers in the gas transmission, petroleum and chemical industries. If you are experiencing, or anticipating, a similar problem, you can consult Burgess-Manning engineers, without obligation, for a guaranteed successful solution.

This is a cross-section of a Snubber typical of many styles used by Burgess-Manning to eliminate pulsation in gas or air pipe lines, or for the suppression of exhaust or intake noise from internal combustion engines, pumps, etc.

SEND US a brief outline of your pulsation or exhaust noise problems and we will gladly send you pertinent literature.

BURGESS-MANNING COMPANY

Sound Engineering

Industrial Silencer Division

9241 Sovereign Row, Dallas, Texas

Libertyville, Illinois

The Trade PARADE

3-MILLIONTH ENGINE. Wisconsin Motor Corp. celebrated its 3,000,000th air-cooled engine to come off the production line. The event added spark to the 50th anniversary of engine progress, being observed during 1959.

The engine was accompanied by an announcement that construction work has started on the company's new $316,000 building to house the engineering department and test laboratory, scheduled for completion by July 1959. Also, Wisconsin Motor has signed a 10-year agreement with Ronaldson Bros. & Tippett, Ltd., of Ballarat, Victoria, Australia, for the manufacture and sale of the air-cooled engines in Australia and other nearby markets.

PLASTICS DIVISION. Nowery J. Smith Company has announced formation of a new division for the design and manufacture of plastic mechanical parts, epoxy and other resin formulations, heavy duty coatings, castings, glass fiber laminates and other plastic materials for industrial use. The new division, PLASTA-MET, will be headed by Stephen J. Stolton.

OFFICES RELOCATE. United States Steel Supply Division has new office and warehouse facilities at Arlington, Tex., midway between Dallas and Ft. Worth. Working space in the 45-ft high steel structure has been increased from the originally planned 39,000 sq ft to about 44,000 sq ft. This new steel service center replaces a smaller building U. S. Steel Supply has been using at 157 Pittsburgh St. in Dallas since 1955, will serve the Northern and Central Texas industrial area. Charles W. Hopkins, manager of the Dallas warehouse, is in charge of the expanded Dallas-Ft. Worth facility.

DIVISION RENAMED. A. O. Smith Corp.'s former Meter, and Service Station Pump divisions and Erie Meter Systems Inc., which A. O. Smith acquired last fall, have been merged and the division now will be known as the Smith-Erie Division. Soon after the new division was established, purchase of the Shand and Jurs Co.'s H.V.S. line of truck and tank fittings of hydraulic emergency valve equipment was announced.

MERGER, "Top Plant", New Division. Texas Instruments, Inc. told of the merger of Metals & Controls Corp. into TI.

A new TI Semiconductor-Components plant was picked as one of the 10 top plants built in the U. S. in 1958 from more than 700 entries. A GeoSciences and Instrumentation division, with Fred J. Agnich (TI vice president) as head, was formed to strengthen the company for space-and-missile age geophysical effort and activity.

ACQUISITION of Fluid Packed Pump Company, Los Nietos, California, is announced by The National Supply Company. Fluid Packed specializes in the manufacture of the "Oilmaster" line of downwell pumping equipment. National Supply has been the international distributor for the company's products, except for a few independent outlets, since 1945. National Supply will operate Fluid Packed as a division, with Sidney Shuman as chief executive officer.

PESA OFFICERS. Wallace D. Wilson was elected president and John G. Staudt vice president of the Petroleum Equipment Suppliers Association. Wilson is president of Wilson Supply Co. Staudt is executive vice president and a director of Dowell Inc., division of Dow Chemical Co. Outgoing PESA president is William T. Powell, executive vice president of Continental-Emsco Co.

NEW STORE. Jones & Laughlin Supply Division announced the completion of a new store building at Rangely, Colorado, to serve the northwestern Colorado area. Also J&L will now distribute flanges, welding fittings and other products manufactured by Taylor Forge and Pipe Works, Chicago.

SOUTHWEST DIVISION. American Meter's subsidiary, Westcott & Greis, Inc., is now the Southwest Division of American Meter Co. Harold W. Wahl will supervise operations as division manager with headquarters in Dallas. James H. Satterwhite, president of Westcott & Greis, is retiring. Cade C. Clover is Northern district manager with headquarters in Tulsa, and Earl B. Cutter Jr., will be Southern district manager with headquarters in Dallas. All Westcott & Greis offices and personnel will continue in the same locations as American Meter.

MANAGERS MEET. BJ Service, Inc.'s division managers meeting in Ft. Worth, was attended by executive and administration personnel, to discuss growth possibilities open to BJ.

At a dinner held, John B. Merritt, president and chief executive officer, honored M. W. (Spike) Fredenburg, safety director, upon his retirement after 23 years, and presented a service pin to R. G. Miller, vice president and assistant general manager, upon his 25th year with the company.

EXCLUSIVE SALES RIGHTS to the "Thermoweld" process for welding copper electrical connections without external power or heat have been acquired by Burndy Corporation who will distribute the product nationally, announced James J. Hennessy, sales manager of the company's utility-industrial division.

DISTRICT SALES AGENT. D. B. Gooch Associates, Inc., was named district sales representative of Buflovak Equipment division, Blaw-Knox Company. Also announced was the opening of a sales office at 3402 Mercer Street, Houston 6, Texas. Harold R. Kibby was transferred from Birmingham, Alabama, to represent Buflovak at the new location. The new office also will be shared by the Power Piping Division's regional sales engineer J. H. Westberry.

CRANE SALES. Lake Shore, Inc., service and supply div., has been appointed an excavator-crane. Hydrocrane, bucket and parts distributor by Bucyrus-Erie Co. Lake Shore's territory includes the Upper Peninsula of Michigan and the northern Wisconsin counties of Ashland, Iron, Vilas, Forest, Florence and Marinette. Mussens Canada Ltd., Montreal, Que., was appointed a distributor for Bucyrus-Erie and Bucyrus-Erie Co. of Canada, Ltd. Distributor's territory includes provinces of Quebec, New Brunswick and Nova Scotia, and Prince Edward Island.

Also announced are plans to establish a research center at Bucyrus-Erie Oak Creek test ground. The first of a group of structures planned for the 125-acre site adjoining Lake Michigan is being constructed by Permanent Construction Co., Milwaukee. The one-story building will have approximately 7200 sq ft of floor space.

SUBSIDIARY. Alpha Corp., a Texas-incorporated subsidiary of Collins Radio Co., was recently formed to design, construct and install complex command and communication functions of electronic systems for both government and industry. This includes not only the electronic system, but also a turn-key installation complete with buildings, roads, towers and other necessary supporting structures for the project. Alpha officials expect to have about 1000 technical and administrative employees within a year, and that some 500 Collins Systems Division personnel are now participating in the type of work to be handled by Alpha. Executives of the new firm are: Max W. Burrell, president; John D. Nyquist, vice president and general manager; D. C. Arnold, marketing vice president; R. J. Flynn, finance vice president; and R. M. Tingoen, engineering vice president. Headquarters are in Dallas, Texas.

EXCLUSIVE MARKET RIGHT. Consolidated Electrodynamics Corp. has granted Van Waters & Rogers, Inc., exclusive right to market two models of CEC's moisture monitors in the 11 western states and part of southwest Texas. Van Waters & Rogers will market the instruments through three divisions — Braun Chemical Company, Braun-Knecht-Heimann Company, and Scientific Supplies Company.

CONTRACT AWARDED. A $1½ million order for 6 of its large type GMW gas engine compressors has been awarded to The Cooper-Bessemer Corp. by the Department of the Interior's Bureau of Mines. The compressors are planned for the newest helium recovery plant at Keyes, Okla. When completed, the Keyes recovery operation will be the fifth plant of its kind for extracting helium from natural gas.

NEW WAREHOUSE. The Dayton Rubber Co. formally opened its new regional warehouse and sales outlet in Atlanta, Ga., on May 1. Located at 1040 Boulevard, S. E., the modern structure is the newest link in the company's growing chain of sales and distribution outlets in key market areas. The new facilities will service the company's industrial, automotive and foam divisions.

ENTRY OF Dayton Rubber Co. into the industrial hose field was announced. The new line will include air, water, steam, suction and pressure hoses in a full range of sizes and construction. Jack O. Quamme was named to the newly-created post of product manager.

SALES REALIGNMENT. Sales Department of Houdry Process Corporation was realigned but will continue to be divided into two broad geographical areas of responsibility. Rophie E. Bland continues as manager of sales for the Western Hemisphere and Henry D. Noll as director, foreign operations, with primary responsibility for sales in the Eastern Hemisphere. David B. Ardern continues as director of technical service worldwide. This combines responsibility for both process sales and petrochemical catalyst sales under one department head. The process and catalysts sales for the petroleum and petrochemical industries will be directed by Joseph W. Schall. Philip A. Burghart will serve as director of chemical and catalyst sales to the chemical industry. Schall and Burghart will report to Bland.

VENEZUELA SUBSIDIARY. Parkersburg Rig & Reel Co. has established a wholly owned subsidiary in Venezuela. Ralph M. Roberts will remain in charge of South American operations with headquarters in Caracas. D. B. Evans will be the representative in Maracaibo, and B. G. McDonald in Anaco. The new subsidiary will operate under the name of The Parkersburg Rig & Reel Co. de Venezuela, C.A.

what does

$$\triangle F/A = \triangle p$$

mean to you?

(Continued on next page)

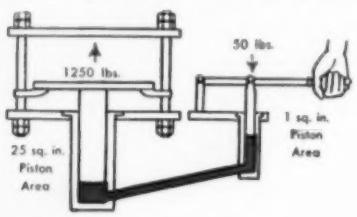
(Continued from preceding page)

$$\triangle F/A = \triangle p$$

. . . is the mathematical expression for Pascal's Principle which states that: "pressure applied to a confined fluid is transmitted uniformly to all areas of the confining fluid."

In the drawing below, notice how a relatively small pressure of 50 pounds applied to the 1 sq. in. piston raised 1,250 pounds on the 25 sq. in. cylinder. Pascal discovered how to multiply the muscles of man a thousand fold! Today, the light touch of a woman's toe against a foot pedal smoothly yet quickly slows and halts a two ton automobile.

Pascal's Principle had been known for hundreds of years when a man by the name of Sven Nordstrom successfully applied the principle to



Here is a demonstration of Pascal's Law. A given pressure of 50 lb lifts 1250 lb over an enlarged area of 50 to 1 ratio

create a most unusual innovation in valves—his invention, the lubricated plug valve. In the most elementary terms, this valve is simply an old fashioned plug cock (used since the days of Pompeii) to which Nordstrom ingeniously applied the Principles of Pascal.

Trade Parade

COMBINES. General Electric Co. is combining its Communication Products Department at Lynchburg, Va., with the Technical Products Department of Syracuse, N. Y. Harrison Van Aken, general manager of the Communication Products Department, will head the combined organization with headquarters in Lynchburg. Two-way radio communications for the petroleum industry will be made in Lynchburg. Previously, this equipment was manufactured at Utica, N. Y.

Terms of purchase of the business, equipment and one plant of GE's Plastics Department by Haveg Industries, Inc. of Wilmington, Dela. were agreed upon by the two companies, say Dr. John Lux, president of Haveg Industries, and Arthur C. Treece, general manager of the Plastics Department of GE.

The sale, which includes the GE plant in Taunton, Mass., is conditional on Haveg's ability to negotiate an acceptable agreement with the union representing Taunton employees.

▸ **Halliburton Oil Well Cementing Co.** Bob Diggs Brown, assistant division manager and division engineer at Houston, moves to Calgary as manager of the Canadian subsidiary, Halliburton Oil Well Cementing Co., Ltd. Succeeding Brown at Houston is Leonard Leon, who has been at New Orleans as division engineer. William E. Robins transfers from Corpus Christi, where he was special tools superintendent, to replace Leon.

A new post, Hydro-Sonic engineer, is being filled at Los Angeles by H. E. "Bill" Gardner, who was assistant division engineer at Corpus Christi. John Coppinger, former division engineer at Abilene, transfers to Corpus Christi in the same capacity. William W. Ball, who has been assistant division engineer at Oklahoma City, transfers to Abilene in the same capacity.

▸ **Harley Sales Co.** Bob R. Neal was recently made president succeeding Roy Neal, who died. He was formerly chief engineer and sales manager. Harley Sales is the oilfield distributor of Wisconsin Motor Corp.

▸ **Schlumberger Well Surveying Corp.** George O. Ellis Jr. was promoted to division sales manager in Billings, Mont. He formerly was district manager at Cody.

Recent promotions and changes in location manager personnel are:

T. W. Cobb was promoted to location manager at Venice, La. H. H. Ham, formerly at Venice, will take over management of the location in Laurel, Miss. L. A. Brasuell is transferred from Wichita to Hays, Kan. J. D. Austin moved from Great Bend, Kan. to Evansville, Ind. R. S. Judson, formerly senior sales engineer at the Gulf Coast division, assigned to Wharton, Tex. and R. M. Porter to Kenmare, N. D.

Schlumberger has also appointed new sales engineers, and reassigned others for better-balanced field service. Midland, Tex. is the base of operations for W. R. Laws, newly appointed sales engineer. R. R. Vann is the new sales engineer at Hobbs, N. M. F. E. Kendrick, sales engineer, moved from Shreveport to Laurel. The new sales engineer at Cushing, Okla. is B. E. Davis. Sales Engineer J. D. Cunningham transferred from Gretna to Venice. Promotions to senior sales engineers include R. C. Cantrell, New Orleans, La. and J. A. Gilreath, Jackson, Miss.

▸ **Air Pollution Control Association.** Arnold Arch has been named executive secretary, leaving the air pollution control directorship of Niagara Falls for his new post July 1. Arch will also serve as Senior Fellow of Mellon Institute, heading the Institute's APCA-sponsored Multiple Air Purification Fellowship. He succeeds Harry Pier.

▸ **American Meter Co.** Dante E. Broggi was elected vice president, previously serving as president and director of Neptune Meter Co.

Edwin R. Clarke is appointed manager—industrial relations. He came to the company from Dayton Rubber Co. where he was director of industrial relations.

▸ **American Steel & Wire, U. S. Steel.** Boyd P. Doty Jr. was named general sales manager, succeeding Howard B. Maguire, retired.

Completion of the new $10 million Scovill Tube Mills at New Milford, Conn., is the latest step in Scovill Manufacturing Co.'s long-range Mills Division expansion and modernization program. The plant contains about 293,000 sq ft, and will turn out copper tube and pipe, heat exchanger tube and general commercial tube.

Allis-Chalmers Manufacturing Co. Four engineers were recently awarded certificates of recognition by the Milwaukee Patent Law Association for their ingenuity and outstanding contributions to society through the patent system. They are: Robert C. Allen, director, mechanical engineering; Alexander J. Roubal, consulting engineer, processing machinery department; William C. Sealey, chief engineer, transformer and regulator departments, and Harold Winograd, consulting engineer, rectifier section.

Homer P. Binder was named consultant and Hugh L. Ross manager of the West Allis pump department of the general products div. Binder has been manager of the department since 1942 and Ross assistant manager of the centrifugal pump department since 1955.

J. E. Despins is appointed manager, Mexico district of Allis-Chalmers de Mexico, S.A., de C.V. He succeeds R. B. Rodriguez, retiring. Despins was manager of the El Paso office.

American Iron & Machine Works. Jim Rea was promoted to district manager, with headquarters in New Orleans, La. Prior to his promotion Rea was a special representative in Tulsa, Okla.

Borg-Warner Mechanical Seals. W. R. Hopson, working out of the Los Angeles office for 2 years, was transferred to the San Francisco office as sales representative. Anno F. Breitenfeldt is new sales representative for the Cleveland office. Larry Blunt is assigned to the Baton Rouge office also as sales representative.

Briggs-Weaver Machinery Co. Darrell Manley was named executive vice president. He will also serve as general manager and director.

Johnston Testers, Inc. L. B. Stansell was promoted manager of the Kansas-Oklahoma area, formerly serving as assistant manager of that area. Norman Andrew is named manager, operations. He was manager of manufacturing.

Byron Jackson Tools, Inc. R. J. Evans Jr. was named vice president and domestic sales manager. He was southern regional sales manager prior to this new position.

Blaw-Knox Co. Ernest E. Swartswelter is elected a director and vice chairman. He was chairman of The Aetna-Standard Engineering Co., recently acquired by Blaw-Knox.

Black, Sivalls & Bryson, Inc. Newton D. Baker, director of employee and public relations, was elected to the newly-created post of marketing vice president.

Babcock & Wilcox. Dr. Lauchlin M. Currie was elected a director. He is vice president in charge of the atomic energy div. Ralph W. Deuster was appointed European nuclear sales representative with headquarters in Brussels, Belgium. He served as assistant to the manager of the propositions and contracts department.

John G. Martin was named domestic sales manager of the boiler division. Succeeding him as manager of the Cincinnati, O., district sales office is William E. Butler, former sales engineer in the Syracuse office of the New York sales district. Charles T. Smith is named an assistant marketing manager also of the boiler division. He was formerly sales engineer in the Philadelphia district office.

James S. Anderson, vice president in charge of sales for the tubular products division, was appointed general manager of the division.

Collins Radio Co. Oliver J. Greenway was named general manager of Communication Accessories Company, a subsidiary.

John Haerle, formerly broadcast sales manager at Collins Radio, was promoted to manager of Texas regional sales with headquarters in Dallas. Ed Gagnon, a former station manager and chief engineer, who has been assistant to the manager of ground communication sales was promoted to succeed Haerle. David H. Foster was named general attorney at the corporate headquarters in Cedar Rapids. Richard F. Flynn, who formerly held the position, is named director of finance in the systems division.

The Western division announced the appointment of Robert W. Landee to director of research and development for airborne data communication. He formerly was assistant director.

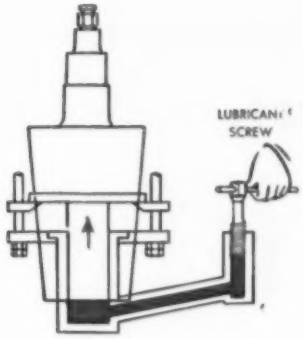
Diamond Power Specialty Corp. William H. Jackson was elected vice president in charge of sales. He was formerly assistant marketing manager of Babcock & Wilcox's boiler division.

Cameron Iron Works, Inc. Homer E. Brown was appointed office manager of the Houston International division. He was transferred from New Orleans where he served as sales liaison director.

Edward E. Parker is named managing director of Cameron Iron Works, Ltd., Leeds, England, a wholly owned subsidiary of Cameron Iron Works. He has been works manager.

Continental-Emsco Company. Jack R. Bechtold was appointed manager of structural sales, headquartered in Dallas, Tex.

The perfect application of a principle



The lubricant system in the Rockwell-Nordstrom valve is a closed hydraulic system acting much like the two pistons shown on the facing page. Instead of having a separate piston to "charge" lubricant into the valve, the screwed lubricant fitting at the top of the plug acts as the first piston. When lubricant is forced through the fitting by a pressure gun or if the lubricant screw is manually turned down, hydraulic force is magnified and forces lubricant through the channels in the plug.

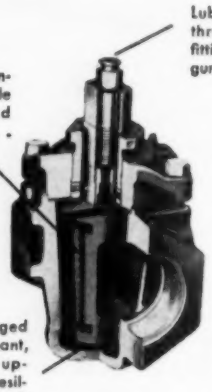
The plug then acts in much the same fashion as the second piston. A shot of lubricant from a pressure gun or a few turns of the lubricant fitting minutely unseats the plug upwards against the resilient shoulder seal, freeing the plug for smooth, easy turning.

(Continued on next page)

(Continued from preceding page)

Here's why Rockwell-Nordstrom valves work better, easier and cost less to use, thanks to

$$\triangle F/A = \triangle p$$


Lubricant injected through Rockwell fitting by pressure gun.
Lubricant through channels in plug forms double pressure seal around each valve port . . . leakage eliminated.
Lubricant chamber, charged with pressurized lubricant, counterbalances plug upwards against slightly resilient shoulder seal. Plug can't be stuck in seat . . . instant, dependable operation.

The drawing above shows how lubricant in Rockwell-Nordstrom valves assures the bottle tight shut-off, smooth, easy operation and unmatched dependability that users have learned to expect over the past forty years. Rockwell-Nordstrom, the *original* lubricated plug valve, is also the world's most complete line. They cost no more to buy, often less, than ordinary valves. Whatever your valve needs, there is a Rockwell-Nordstrom valve that will do the job better, longer and at lower cost. If you'd like to know more about these valves or if you'd like to talk with a Rockwell field sales engineer, write Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

it's ROCKWELL

MANUFACTURING COMPANY

Trade Parade

Core Laboratories, Inc. Stan Dickerson, sales engineer, was recently reassigned to the Mid-Continent area. He will headquarter at the firm's Oklahoma City lab. Previously, he operated from the San Antonio lab of the Corpus Christi district.

Crossett Chemical Co. Tom C. Clarkson was appointed sales manager, previously serving as manager of chemical products sales.

Dowell. R. D. Fagan was transferred to technical services and development department as engineer. He will be responsible for the development of cementing services on the Gulf Coast and in the Permian Basin, reporting to Joseph B. Stewart, manager.

Dodge Manufacturing Corp. J. Allan MacLean became president succeeding Joseph E. Otis Jr., who was elected chairman of the board.

MacLean formerly served as group executive and general manager of Bendix products division of Bendix Aviation.

Du Pont Co. Herman R. Woodall, manager of the chemical sales section in the explosives department, was promoted to assistant director of sales for chemical and specialty products. Tom T. Brown, assistant manager of the Duluth, Minn., sales district, succeeds Woodall as manager of the chemical sales section. William Reynolds, assistant manager of the chemical sales section, is special assistant to the director of sales.

John R. Sabina was named manager of the tetraethyl lead and planning section of the petroleum chemicals division, succeeding T. Baldwin Prickett, retired.

Clark Bros. Co., Dresser Industries, Inc. F. W. Laverty was appointed president. Laverty has been executive vice president since 1953, and previously was sales manager.

J. N. MacKendrick, president until the present time, was appointed chairman of the board. He replaces C. Paul Clark, who has been given the post of honorary chairman.

Foxboro Company. R. Milham was appointed manager of international sales, formerly serving as manager of the mechanical instrument sales division. G. H. Gleason, who will assist with international operations, served as manager of the Philadelphia branch.

Franks Division, Cabot Shops, Inc. Clyde M. Lackey was named sales manager, formerly serving with the sales division of Cardwell Mfg. Co.

Grant Oil Tool Company. Robert E. Masters was elected a vice president. He is general manager of the MacClatchie division.

Gardner-Denver Company. Charles M. Mayhew was elected a director. He is vice president of the Mayhew Machine and Mayhew Supply Companies. Mayhew succeeds the late Howell W. Murray. Re-elected directors were: Ralph G. Gardner, chairman; Arthur D. Chilgren; E. Vincent Erickson; Benjamin C. Essig; John W. Gardner; Arthur E. Johnson; Gifford V. Leece; Alexander G. Lindquist, and Bernath P. Sherwood, Jr. All officers were re-elected.

Graver Tank & Mfg. Co. William H. Dwyer Jr., was appointed manager of Mid-Continent and Gulf Coast sales. He previously was manager of Gulf Coast sales. Charles P. MacDonald was promoted to assistant product manager at the oil & gas equipment plant in Sand Springs, Okla. E. G. Vail named plant manager of the Sand Springs plant and will be in complete charge of all manufacturing operations.

General Electric. Charles W. George was appointed manager-engineering for the gas turbine department, after serving as manager of SAR reactor engineering at the Knolls atomic power laboratory in Schenectady.

Four new managers in the service shops department are: R. F. Coles named manager of the Toledo service shop; T. M. Hushen, manager of the Salt Lake City service shop; A. W. Warren, manager of the Richmond service shop and C. L. Wilhelm, will head the Youngstown, O., service shop. Dr. G. E. Adams and R. J. Noorda were made operations analysts in the computer department. Guy E. Warner was named sales manager of process computers in the same department.

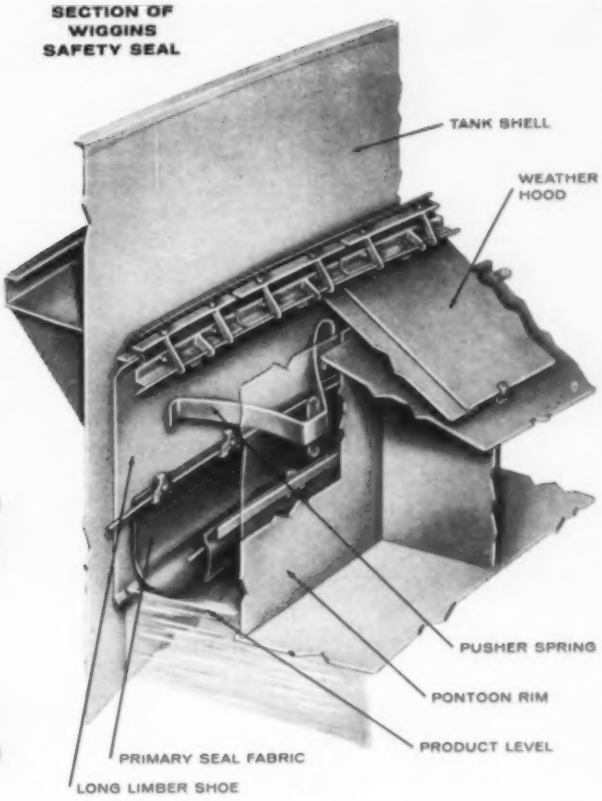
Jefferson Chemical Co. Leroy Whitaker was named market development man in the commercial development division, reporting to William C. Bedoit Jr., manager.

The Brewster Company. Jerry O. Price, 10-year veteran of oil field equipment sales, has rejoined the company as a sales representative. With Associated Oil Field Rentals in New Orleans and Lafayette during the past year, Price formerly served as a key Brewster sales representative for 9 years.

International Nickel Co., Inc. Thomas Archibald Stone has been appointed special assistant to the president of International Nickel of Canada, Ltd. Stone, Canadian Ambassador to the Netherlands from 1952 until last year, resigned from the Department of External Affairs at Ottawa.

ONLY THE WIGGINS FLOATING ROOF *with* SAFETY SEAL

SECTION OF WIGGINS SAFETY SEAL



GIVES YOU MAXIMUM PROTECTION AGAINST FIRE, PRODUCT LOSS AND COSTLY MAINTENANCE

Look at these 9 points of superiority:

1. *Safety Seal* exclusive design eliminates critical vapor spaces, does away with rim fires.
2. *Safety Seal* eliminates losses from thermal breathing.
3. No metal working parts ever touch the liquid.
4. Weather hood protects *Safety Seal* fabric from the elements.
5. *Safety Seal* makes tanks safe for highly volatile, highly flammable liquids.
6. Air-vapor volume less than 10% of conventional seals.
7. *Safety Seal* is specially compounded to resist deterioration . . . much longer life than ordinary seals assured.
8. No rust or scale can deposit in the seal loop.
9. *Safety Seal* is easy to inspect, easy to maintain.

A Floating Roof is only as good as its Seal.

Wiggins Floating Roofs are in a class by themselves . . . pay for themselves with the savings they provide.

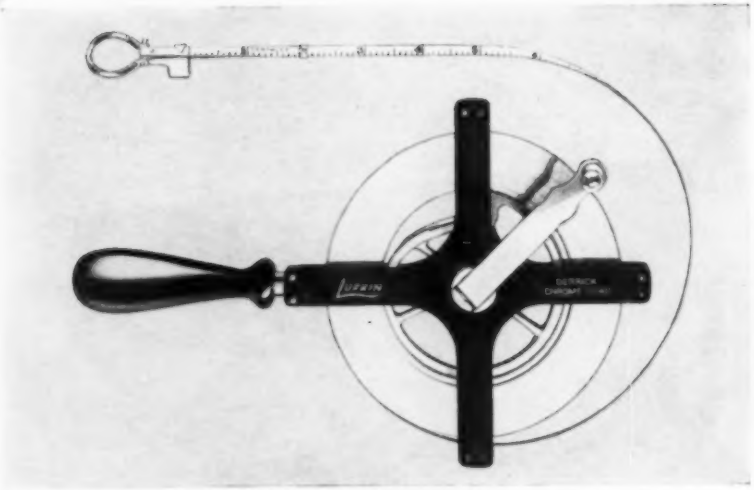
Call the nearest General American office, or write. You'll find that here, as in so many fields, *it pays to plan with General American.*

Plate and Welding Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street • Chicago 90, Illinois

Offices in principal cities

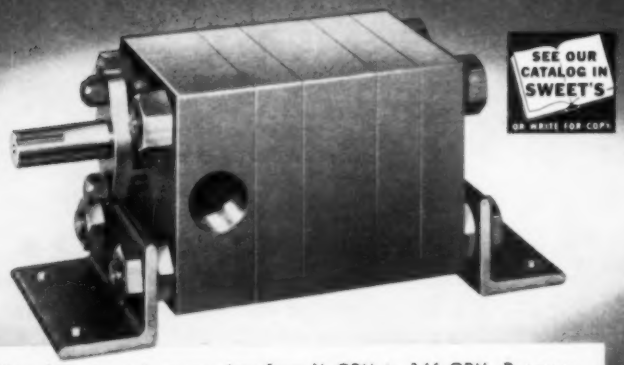


Lufkin Chrome Clad® Derrick Tape resists corrosion like no other. Won't rust, chip, crack or peel!

THE LUFKIN RULE COMPANY
TAPES • RULES • PRECISION TOOLS
SAGINAW, MICH. • MIDDLETOWN, N.Y. • BARRIE, ONT.

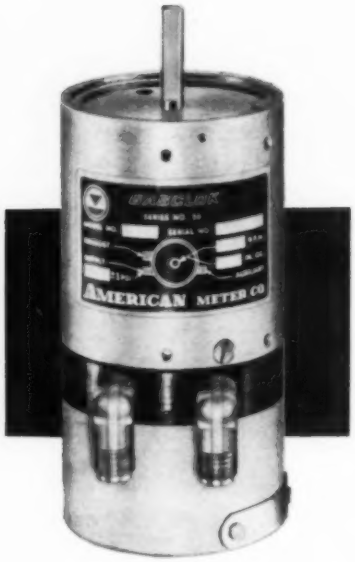
NORTHERN NITRALLOY PUMPS

Lube oil, seal oil and fuel oil pumps for compressors and engines



Complete range in pump sizes from ¼ GPM to 146 GPM. Pressures to 2000 PSI. Proven in thousands of installations and backed by 50 years of engineering and production experience, Northern Steel Block Nitralloy Rotary Gear Pumps are unexcelled for precision manufacture, accurate assembly and dependable, long life operation. Write for free catalog and engineering data.

NORTHERN ORDNANCE, INCORPORATED
Subsidiary
NORTHERN PUMP COMPANY
MINNEAPOLIS 21, MINN.



AMERICAN® GASCLOK POWER DRIVE

Completely self-contained gas or air-powered instrument driving and timing unit for long, trouble-free operation in remote locations. The GASCLOK delivers more than 20 times the torque of conventional spring-wound mechanisms. Continuous timing accuracy is unaffected by a ± 20% variation in supply pressure.

Inherently explosion proof and self-starting, the GASCLOK is ideal as original or replacement equipment for strip chart and conventional circular chart instruments. The timing mechanism is internally sealed to prevent corrosion, and all power unit parts exposed to gas are aluminum or stainless steel. Large area internal ports prevent clogging. Normal air or gas consumption 5 cfh . . . operating pressure 5 psi . . . rotation 2 rpm.

AMERICAN®
METER COMPANY
INCORPORATED (ESTABLISHED 1836)

Executive Offices: Philadelphia 16, Pa.
Sales offices in principal cities.

Golden safety hat. J. B. O'Connor, president (left), and H. N. Mallon, chairman of the board, Dresser Industries, Inc., present Engr. Pascual Gutierrez Roldan (center), newly appointed director general of Petroleos Mexicanos (Pemex) with golden symbol of petroleum workers, and welcome him into the "Fraternity of Oil Men" at a Dallas (Texas) luncheon held in his honor.

Jones & Laughlin Supply Division. Jack Judd, manager-drilling equipment section, general products sales, is promoted to assistant manager of sales-general products at Houston. W. O. Hardy is manager at Tulsa. C. E. Bogle, manager-wire rope section, general products sales succeeds Judd at Tulsa. Six salesmen transferred to different stores or sales offices are: R. J. Bevington, formerly salesman at Freer, Tex., transferred to McAllen, Tex.; R. D. Landis, salesman, from Alice, Tex., to Freer; C. L. Wallace, salesman at Houma, La., to Brookhaven, Miss.; B. W. Ramsey, salesman at Lake Charles store, to Houma; H. E. Reeves, salesman at Brookhaven, to Natchez, Miss.; D. R. McKown, salesman at Williston, N. D., to Houston sales office. P. A. Toomey, storeman, at Williston, is promoted to salesman and T. D. Gholson is assigned as salesman at the Houston sales office.

Long Manufacturing Division, Borg-Warner Corp. Harry H. Whittingham was elected president and general manager. He has been executive vice president and assistant general manager.

RECEIVES AWARD. Schlumberger Well Surveying Corp. has received an "Award of Merit" for its 1958 advertising campaign from Associated Business Publications. Individuals receiving credit in the award were R. R. Rieke, Schlumberger sales manager, and Earl Rives, of Rives, Dyke and Company Advertising. The Award of Merit was the only one in the 1958 competition won by an oil industry equipment and/or service company.

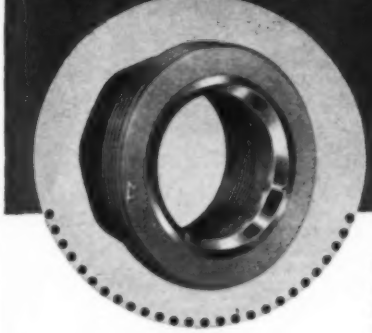
Earl Rives, left, presents award of merit plaque to Schlumberger President, W. J. Gillingham (center), and Sales Manager R. R. Rieke.

CLAYTON MARK

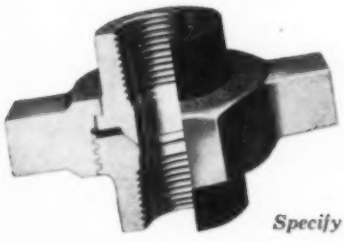
Petro and Handlebar

UNIONS

feature for feature are SUPERIOR



COLD-ROLLED FEMALE SEAT . . . for extremely tight sealing. The operation of cold-rolling under intense pressure results in a harder female seat that seals perfectly with the male seat, to handle even the most volatile fluids. This quality feature, combined with a superior forging steel and fourteen other outstanding features, gives you the *one* union that offers the widest application in high pressure – high temperature piping.



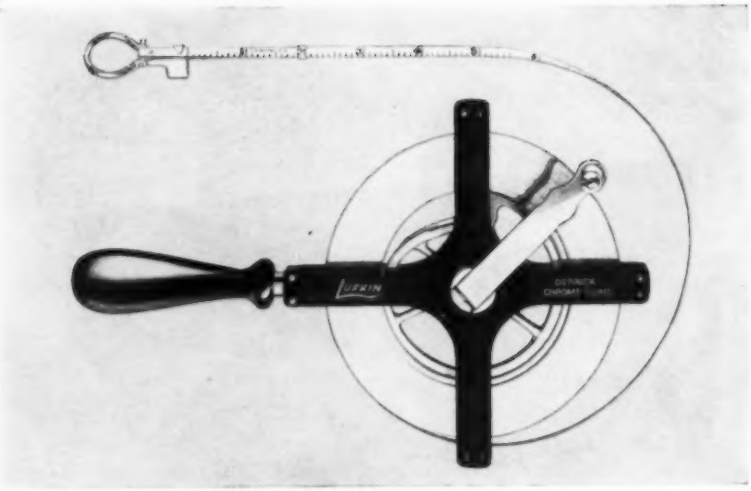
Specify the brand–CLAYTON MARK!

Write today for free booklet "What makes a good union?"...

CLAYTON MARK & COMPANY

1900 Dempster Avenue • Evanston, Illinois

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

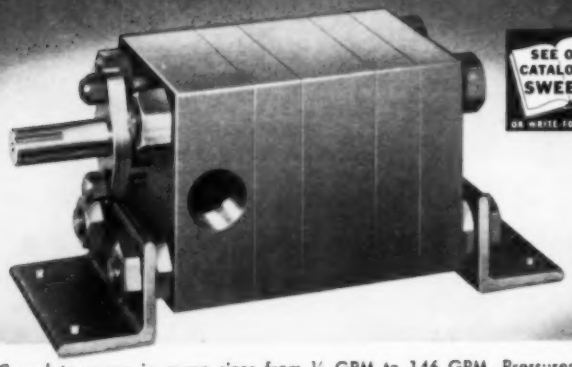


Lufkin Chrome Clad® Derrick Tape resists corrosion like no other. Won't rust, chip, crack or peel!

THE LUFKIN RULE COMPANY
TAPES • RULES • PRECISION TOOLS
SAGINAW, MICH. • MIDDLETOWN, N.Y. • BARRIE, ONT.

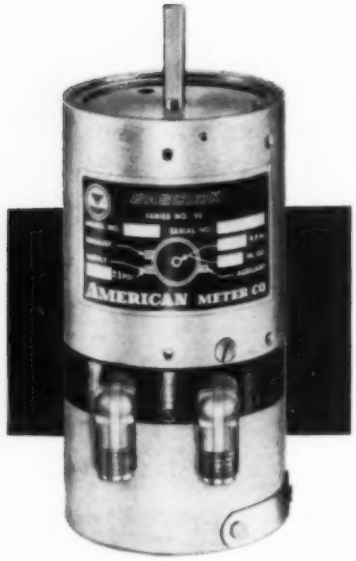
NORTHERN NITRALLOY PUMPS

Lube oil, seal oil and fuel oil pumps for compressors and engines



Complete range in pump sizes from ¼ GPM to 146 GPM. Pressures to 2000 PSI. Proven in thousands of installations and backed by 50 years of engineering and production experience, Northern Steel Block Nitralloy Rotary Gear Pumps are unexcelled for precision manufacture, accurate assembly and dependable, long life operation. Write for free catalog and engineering data.

NORTHERN ORDNANCE, INCORPORATED
Subsidiary
NORTHERN PUMP COMPANY
MINNEAPOLIS 21, MINN.



AMERICAN® GASCLOK POWER DRIVE

Completely self-contained gas or air-powered instrument driving and timing unit for long, trouble-free operation in remote locations. The GASCLOK delivers more than 20 times the torque of conventional spring-wound mechanisms. Continuous timing accuracy is unaffected by a ± 20% variation in supply pressure.

Inherently explosion proof and self-starting, the GASCLOK is ideal as original or replacement equipment for strip chart and conventional circular chart instruments. The timing mechanism is internally sealed to prevent corrosion, and all power unit parts exposed to gas are aluminum or stainless steel. Large area internal ports prevent clogging. Normal air or gas consumption 5 cfh . . . operating pressure 5 psi . . . rotation 2 rpm.

AMERICAN®
METER COMPANY
INCORPORATED (ESTABLISHED 1836)

Executive Offices: Philadelphia 16, Pa.
Sales offices in principal cities.

Golden safety hat. J. B. O'Connor, president (left), and H. N. Mallon, chairman of the board, Dresser Industries, Inc., present Engr. Pascual Gutierrez Roldan (center), newly appointed director general of Petroleos Mexicanos (Pemex) with golden symbol of petroleum workers, and welcome him into the "Fraternity of Oil Men" at a Dallas (Texas) luncheon held in his honor.

Jones & Laughlin Supply Division. Jack Judd, manager-drilling equipment section, general products sales, is promoted to assistant manager of sales-general products at Houston. W. O. Hardy is manager at Tulsa. C. E. Bogle, manager-wire rope section, general products sales succeeds Judd at Tulsa. Six salesmen transferred to different stores or sales offices are: R. J. Bevington, formerly salesman at Freer, Tex., transferred to McAllen, Tex.; R. D. Landis, salesman, from Alice, Tex., to Freer; C. L. Wallace, salesman at Houma, La., to Brookhaven, Miss.; B. W. Ramsey, salesman at Lake Charles store, to Houma; H. E. Reeves, salesman at Brookhaven, to Natchez, Miss.; D. R. McKown, salesman at Williston, N. D., to Houston sales office. P. A. Toomey, storeman, at Williston, is promoted to salesman and T. D. Gholson is assigned as salesman at the Houston sales office.

Long Manufacturing Division, Borg-Warner Corp. Harry H. Whittingham was elected president and general manager. He has been executive vice president and assistant general manager.

RECEIVES AWARD. Schlumberger Well Surveying Corp. has received an "Award of Merit" for its 1958 advertising campaign from Associated Business Publications. Individuals receiving credit in the award were R. R. Rieke, Schlumberger sales manager, and Earl Rives, of Rives, Dyke and Company Advertising. The Award of Merit was the only one in the 1958 competition won by an oil industry equipment and/or service company.

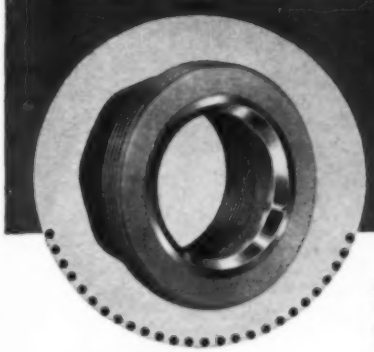
Earl Rives, left, presents award of merit plaque to Schlumberger President, W. J. Gillingham (center), and Sales Manager R. R. Rieke.

CLAYTON MARK

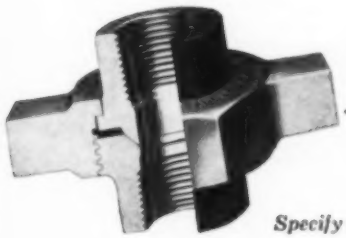
Petro and Handlebar

UNIONS

feature for feature are SUPERIOR



COLD-ROLLED FEMALE SEAT . . . for extremely tight sealing. The operation of cold-rolling under intense pressure results in a harder female seat that seals perfectly with the male seat, to handle even the most volatile fluids. This quality feature, combined with a superior forging steel and fourteen other outstanding features, gives you the *one* union that offers the widest application in high pressure – high temperature piping.



Specify the brand–CLAYTON MARK!

Write today for free booklet "What makes a good union?"...

CLAYTON MARK & COMPANY

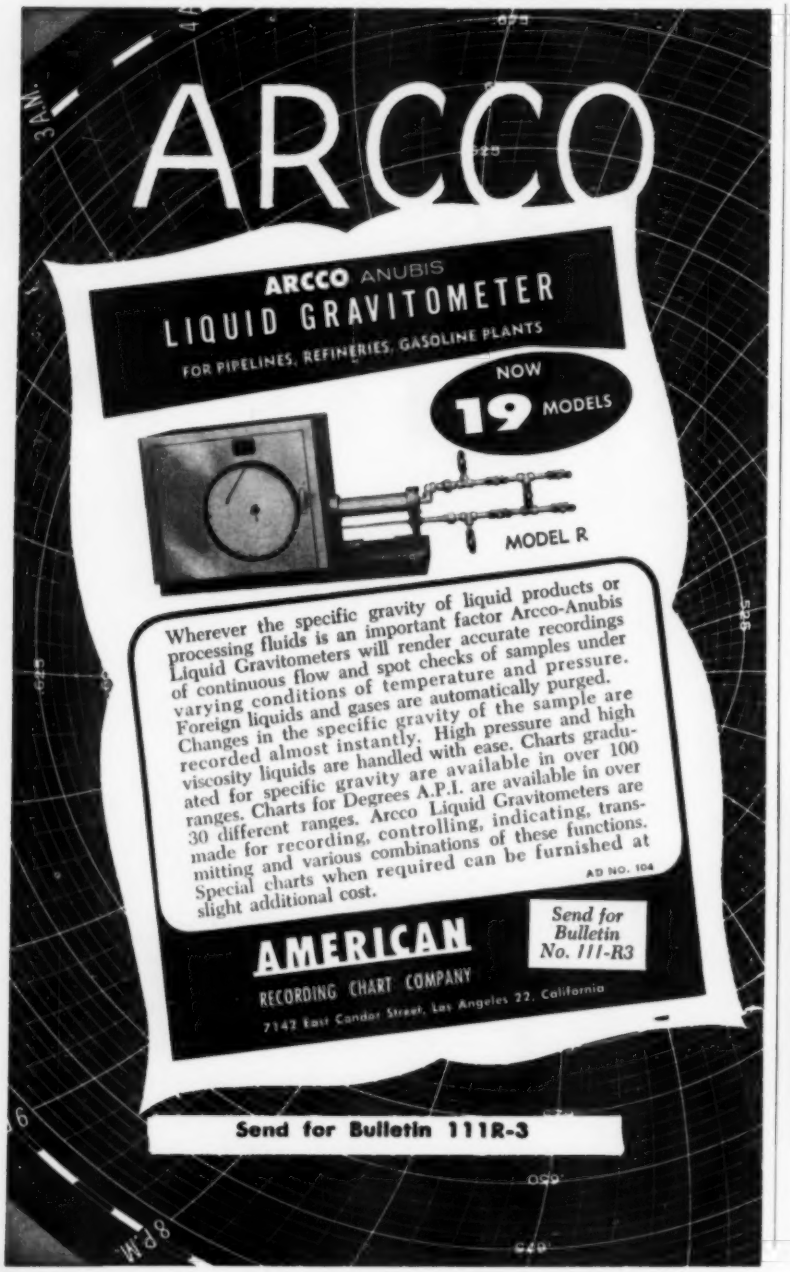
1900 Dempster Avenue • Evanston, Illinois

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

ENLARGED OFFICES. Several additions and enlargements to the Oil Equipment Manufacturing Co.'s plant and office in Louisville, Ky., have been made.

A large extension was added to the manufacturing and shipping departments to permit faster movement of finished products. Offices and engineering departments are now housed in a two-story brick building connecting with the plant proper. The foundry is located at the far rear of the remodeled building.

Milwhite Mud Sales Co. Martin Wheeler has joined the company as their sales representative in the Oklahoma City area, previously he was with Fox Rig and Lumber Company.


ARCCO
ARCCO ANUBIS
LIQUID GRAVITOMETER
FOR PIPELINES, REFINERIES, GASOLINE PLANTS
NOW
19 MODELS
MODEL R
Wherever the specific gravity of liquid products or processing fluids is an important factor Arcco-Anubis Liquid Gravitometers will render accurate recordings of continuous flow and spot checks of samples under varying conditions of temperature and pressure. Foreign liquids and gases are automatically purged. Changes in the specific gravity of the sample are recorded almost instantly. High pressure and high viscosity liquids are handled with ease. Charts graduated for specific gravity are available in over 100 ranges. Charts for Degrees A.P.I. are available in over 30 different ranges. Arcco Liquid Gravitometers are made for recording, controlling, indicating, transmitting and various combinations of these functions. Special charts when required can be furnished at slight additional cost.
AD NO. 104
AMERICAN
RECORDING CHART COMPANY
7142 East Condor Street, Los Angeles 22, California
Send for Bulletin No. 111-R3
Send for Bulletin 111R-3

Larkin Packer Co. Lloyd Helmer was appointed sales manager of Larkin Products Ltd. He has been a salesman for Larkin Packer covering the Calgary area and Saskatchewan. He will continue in these areas in addition to his new duties. Covering the Edmonton area is Don Wilson.

Lufkin Foundry & Machine Co. Robert Lang served as panel moderator during the annual meeting of the Texas Chapter of the American Foundrymen's Society held in Lufkin on April 24. Lang's panel discussed gray iron castings. Other panel moderators during the meeting included Ross Williams of the East Texas Castings Co., and R. A. Colton of Federated Metals.

Kellogg Switchboard and Supply Co. Holmes D. McLendon was named sales manager of commercial products for Kellogg, communications division of International Telephone and Telegraph Corp.

C. A. Gunn, industrial sales manager, was elected chairman of the Petroleum Electrical Supply Association. He was also re-elected to the board of directors.

Tuboscope Company. Harold Schneider was appointed manager of the quality control department. He will supervise the training of personnel, serve as technical advisor to sales department, and will also manage the safety and fleet programs.

The Marley Co. Leon T. Mart is elected chairman of the board. He founded the company and has been president during the 37 years of its operation. J. A. Cameron Jr. was elected president. For the past 6 years he has been executive vice president. M. A. Patton, head of research and development, advanced to vice president in charge of these operations.

Nordberg Mfg. Co. Carroll E. Dietle was appointed general sales manager of the engine division, headquartering in the main offices in Milwaukee. Dietle was manager of the diesel division of Fairbanks Morse & Co.

VALVE DISTRIBUTOR. Jones & Laughlin Supply Division announced an agreement to distribute Rockwall-Nordstrom Plug Valves through their stores and sales offices. These valves are manufactured by Rockwell Manufacturing Co.

J & L Supply, a division of Jones & Laughlin Steel Corp., has 80 stores and 33 sales offices throughout the oilfields of the U. S. and Canada.

Rainey Elliott, president, Jones & Laughlin Supply Division (right), and Roy R. Bush, regional sales manager, Rockwell Manufacturing Company, meet to sign a new sales agreement.

RUST-OLEUM®

STOPS RUST!®

and matches ORIGINAL EQUIPMENT

COLORS

Distinctive as your own fingerprint. Accept no substitute.

How much does rusty equipment cost *you*? With Rust-Oleum, you STOP RUST—and you match original equipment colors, too, for long-lasting protection!

We want you to see for yourself how *easy* it is to use Rust-Oleum . . . actually take the brush and see how smoothly it works, how it dries to an *attractive, high-gloss finish* that resists sun, fumes, rain, heat, snow, salt air and salt spray, and blowing dust and sand. And the same formula can be applied by brush or spray. Just check the coupon for the color you want . . . and attach it to your business letterhead for a FREE TEST SAMPLE. No cost or obligation.

Your Rust-Oleum Distributor maintains complete stocks for immediate delivery.

ATTACH COUPON TO YOUR BUSINESS LETTERHEAD FOR FREE TEST SAMPLE

CHECK COLOR TO MATCH YOUR EQUIPMENT

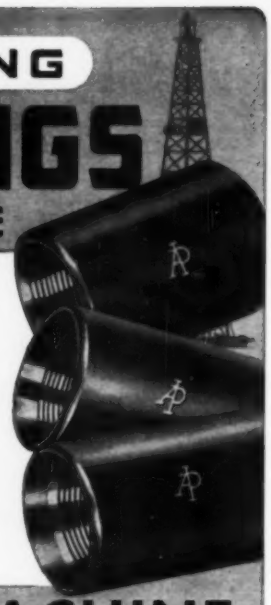
RUST-OLEUM CORPORATION, 2633 Oakton St., Evanston, Ill.

Please send me a FREE TEST SAMPLE in the color checked:

- ☐ 769 Damp-Proof Red Primer
- ☐ H-50 Primer
- ☐ 634 Quick Drying Black
- ☐ 2766 High Gloss White
- ☐ 470 Ready Mixed Aluminum
- ☐ H-4 Caterpillar Yellow
- ☐ 722 Bethlehem Yellow
- ☐ 728 Old Emsco Green
- ☐ 726 New Emsco Green
- ☐ 727 New Unit Rig Gray
- ☐ 724 Waukesha Gray
- ☐ 725 New National Blue
- ☐ 723 Oil Well Orange

WHEELING
COUPLINGS
FOR OIL COUNTRY USE

LINE PIPE COUPLINGS — 1/8" to 12" — Seamless — Black or Galvanized
PLAIN TUBING COUPLINGS A. P. I. — 1" to 4" — Seamless
EXTERNAL UPSET TUBING COUPLINGS A. P. I. — 3/4" to 3 1/2" — Seamless
CASING COUPLINGS A. P. I. — 4 1/2" to 13 3/8" — Long or Short
HYDRAULIC COUPLINGS — 1/8" to 4" — Seamless
REAMED AND DRIFTED A. I. S. I. — 3/4" to 12" — Seamless
DRIVE PIPE COUPLINGS — 6" to 12" — Seamless
PIPE NIPPLES — All Sizes and Types
STEEL BUSHINGS AND PLUGS — Merchant and High Pressure



WHEELING MACHINE PRODUCTS COMPANY
WHEELING, WEST VIRGINIA
WEST COAST FACTORY: WOODLAKE, CALIFORNIA

DESIGNED, TESTED AND PROVEN IN THE OIL FIELDS

Screened Air Port

Unexcelled . . . for Outdoor Use

- DRIP PROOF
- VERMIN PROOF
- MOISTURE PROOF
- CORROSION RESISTANT
- FORCED AIR COOLED

All these features of Fieldmaster Ball Bearing Motors have been designed to overcome the rugged conditions of Oil Field requirements.

FIELDMASTER

CHECK THESE OUTSTANDING ADVANTAGES.

Heavy Cast base for alignment, stability, heavy duty, double-shielded, prelubricated bearings, reduces lubrication worries, high grade silicon steel in the magnetic circuit reduces iron losses . . . Wide variety of windings provides triple ratings, dual voltages . . . high torque licks heavy starting problems. High slip is available to take care of reciprocating load requirements encountered in pumping.

Write For Descriptive Literature.

BETHLEHEM STEEL CO. TULSA, OKLAHOMA
SUPPLY DIVISION
Manufactured by VALLEY ELECTRIC CORPORATION, St. Louis, 8, Mo.

Trade Parade

Mid-Continent Supply Co. Thomas N. Shults was elected president filling a vacancy left by D. H. Thornbury, elected chairman of the board and chief executive officer. P. Z. Hilliard, general division manager, was promoted to the office of vice president.

Named as export manager in New York is L. T. Ratliff, who was formerly Tulsa division manager. R. L. McAnally was promoted to division manager in the Denver office, formerly the Denver division sales manager. J. O. Ramsey moved from assistant division manager to division manager in the New Orleans office. New division manager in Houston is J. L. Voss, formerly Houston division sales representative, and division manager in Midland is W. W. Arnold, former Denver division manager. The division manager in Wichita Falls, C. H. Hickman is new division manager in Tulsa with R. S. Weilman moving to Wichita Falls from Houston.

Assuming new duties in South America is L. B. Levell. From his Buenos Aires office, Levell will serve as agent for Argentina, Bolivia, Peru, Brazil, Chile, Paraguay and Uruguay. He was formerly assistant sales manager in Fort Worth.

Massey-Ferguson Industrial Division. Cornelius Whetstone was named marketing manager. He was formerly general sales manager of the Trojan division of Yale and Towne Manufacturing Co.

Otis Engineering Corp. Carl W. Zimmerman was named manager of the electrical engineering division in the research and development department. Zimmerman previously was senior project supervisor for Well Surveys, Inc.

Minneapolis-Honeywell Regulator Co. Fred Maytag II, president of the Maytag Co., was elected a director of Minneapolis-Honeywell.

Oil Well Supply Div., U. S. Steel. Larry B. Kent, field representative at Estevan, Saskatchewan, becomes store manager there. Charles V. Black, city representative at Abilene, Tex., is new store manager there. New area representative at Calgary is Howard Rainbird with Stanley D. Strand replacing him as area manager — tubular sales. He was in Toronto Ont., as area representative. James E. Chenault Jr., was named district manager at Edmonton.

W-K-M, division of ACF Industries, Inc. Henry C. Tooley was appointed plant manager for the Missouri City plant. He was formerly with Reed Roller Bit as executive vice president prior to joining Cameron Iron Works for a special assignment.

WANTED: INSTRUCTOR for classes in petroleum technology to begin employment during summer. Degree in engineering plus extensive experience in phases of the petroleum industry desired. *Contact President Murray H. Fly,* Odessa College, P. O. Box 3752, Odessa, Texas.

POPULAR HARRIS HOTEL IN New York City
TIMES SQUARE
HOTEL 43rd St. just West of Broadway
1000 Fine Rooms from $4
TOBY KRYE Manager
PHONE: LA 4-6900
AIR CONDITIONING
TELEVISION
In the heart of Times Square N.Y.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

You're never stuck with a GROVE VALVE

Here's the valve you set and forget. Grove's exclusive Seal-O-Rings wipe out the need for valve lubrication. You're never stuck with valve failure because of forgotten lubricant or depleted sealing compound. The load of lubrication is gone forever. Specify Grove Seal-O-Ring Gate Valves. Under pressure the tightest seal in the line.

Grove valves never require lubrication

GROVE VALVE and REGULATOR COMPANY

A Subsidiary of Walworth

65th & Hollis Street, OAKLAND 8, California

HOUSTON 27—3203 Mercer St. • LOS ANGELES 6—2559 W. Olympic Blvd.

ODESSA • TULSA • DENVER • CHICAGO • NEW YORK • DALLAS • PITTSBURGH

FARMINGTON, N. M. • LAFAYETTE, LA. • HARVEY, LA. • LONGVIEW, TEXAS

In Western Canada: GROVE VALVE LTD., EDMONTON

Clean PIPELINES
Reclaim TANK BOTTOMS

with

BrakeSol

an exclusive

PARAFFIN TREATING CHEMICAL

BRAKESOL holds paraffin in suspension! Inject it into gathering lines and BRAKESOL keeps them free of paraffin.

BRAKESOL reclaims tank bottoms without taking tanks out of service! BRAKESOL chemically dissolves paraffin and puts it back in solution into the oil. Cost is nominal compared to savings.

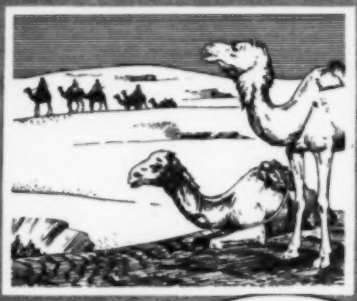
BRAKESOL is safe to handle and will not harm your equipment. Let BRAKESOL eliminate your paraffin problems NOW!

FOR SERVICE . . . Contact your Supply Store or nearby BrakeSol Treating Engineer.

BrakeSol INC.

P. O. BOX 9506 • OKLAHOMA CITY, OKLA.
EXPORT DISTRIBUTOR THE NATIONAL SUPPLY CO., EXPORT DIVISION

PIPELINES
are in the NEWS



Watch – **WILLIAMS BROTHERS**

ENGINEERS-CONSTRUCTORS

Rockefeller Center — NEW YORK CITY
Washington — Pittsburgh — Louisville
Minneapolis — New Orleans — Caracas
Bogota — La Paz — Edmonton
Calgary — London — Ankara — Tehran

NBT BLDG.
TULSA
—
Cable
WILLBROS.

OIL • GAS • WATER • PRODUCTS
PUMPING STATIONS AND PIPELINES

Bring your
ABC Transactions
to the Mercantile
for prompt and sound

FINANCING

Call RI 1-4181 or write
OIL and GAS
DEPARTMENT

MERCANTILE NATIONAL BANK
DALLAS, TEXAS

INSTANT START, NO BATTERIES WITH

I-R

AIR STARTING MOTORS!

Dependable: Fast, positive starts regardless of temperature. Made by the originators of Air Starting Motors.

Low cost: Eliminates batteries, generators, electrical parts and their maintenance.

Less weight: I-R Air Starting Motor installations weigh less than conventional batteries and generators . . .

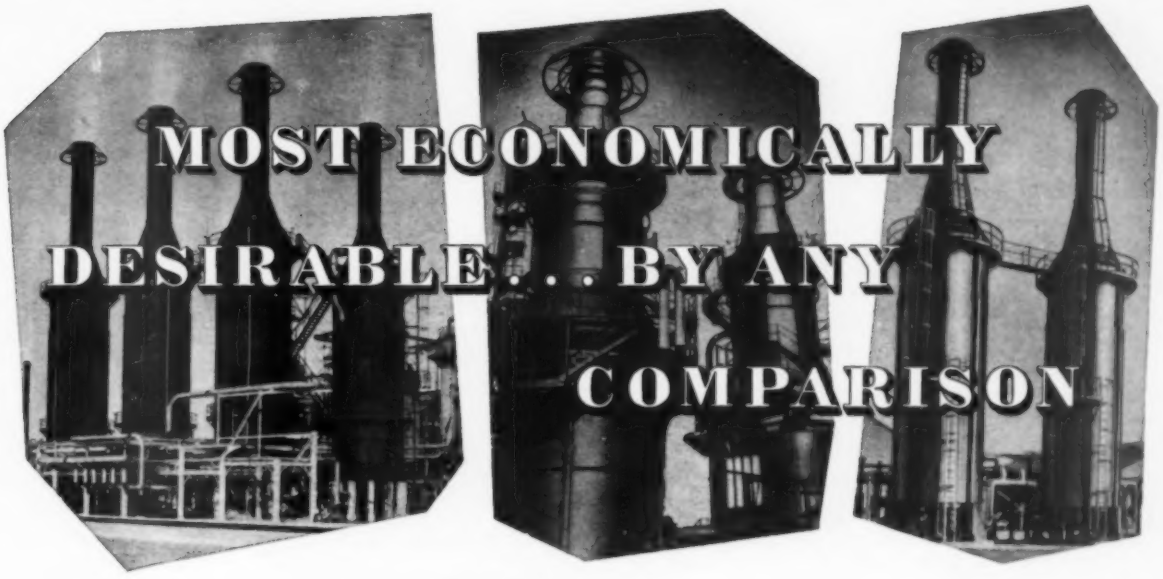
Three sizes: I-R Air Starting Motors are made in models to meet the needs of almost all stationary, auxiliary and motive engines.

Ingersoll-Rand
11 Broadway, New York 4, N.Y.

Write for new Air Starting bulletin Form 5094D.

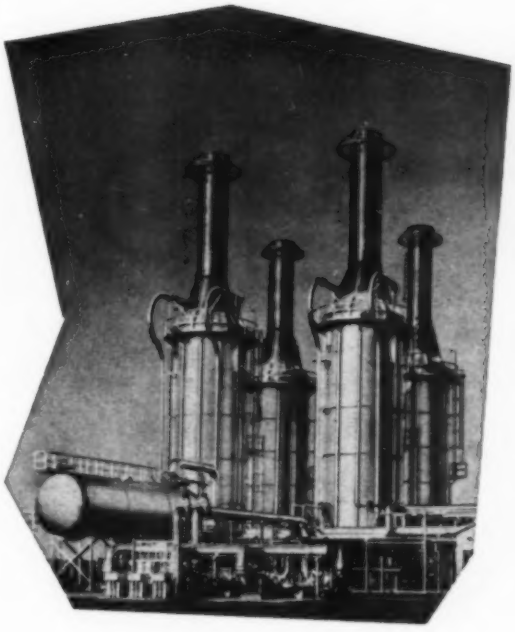
18-769

PETROCHEM-ISOFLOW FURNACES



MOST ECONOMICALLY DESIRABLE . . . BY ANY COMPARISON

in every country of the free world for every process heating requirement



PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

REPRESENTATIVES: Pavilio-LoValley, Chicago • Flagg, Brackett & Durgin, Boston • H. B. Fenton, Pittsburgh • William N. Nason, Tulsa • Lester Oberholtz, Los Angeles • Petrochem Isoflow Furnaces, Ltd., Toronto • Rawson-Houlihan Co., Houston • Rawson Co., Baton Rouge • Rittelmeyer, Atlanta • H. W. Severance, Prospect, Ky. • Turbex Equipment, Herberth, Pa. • G. M. Wallace, Denver, El Paso & Salt Lake City International Licensees and Representatives: Birwico Ltd., Birmingham, England • Fujinagata Shipbuilding, Osaka & Tokyo, Japan • Heurtey Italiana, S.P.A., Milan, Italy • Petrochem G.M.B.H., Dusseldorf, Germany • SETEA S.A., Buenos Aires, Argentina • Societe Anonyme Heurtey, Paris, France • Societe Anonyme Belge Heurtey, Liege, Belgium

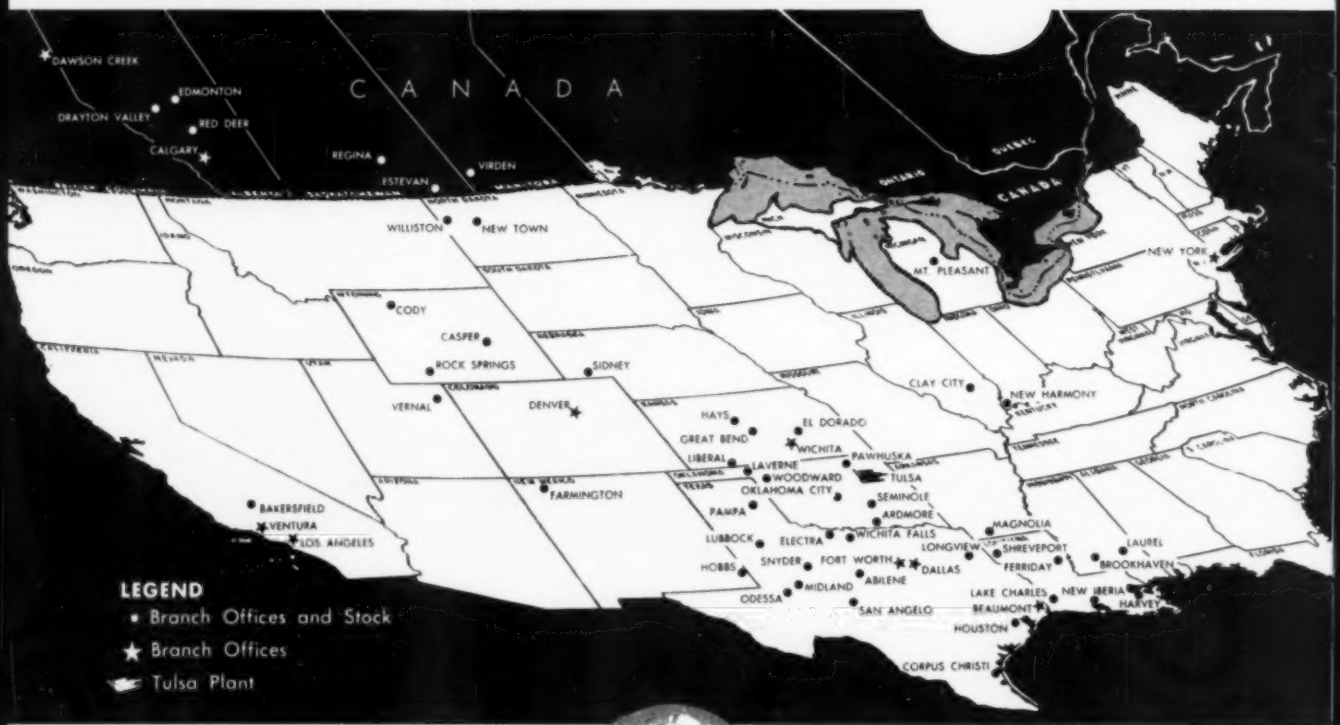
TANKS

when you think of tanks . . .
think of **NATIONAL®**

National Tank Company offers you the best in engineering, fabrication, installation and service.

This map locates National's own branch offices, wareyards and crew bases. When you need tanks for GRAIN, CEMENT, OIL, WATER OR ANY GRANULAR OR LIQUID MATERIAL — CONTACT YOUR NEAREST NATIONAL OFFICE*.

**You'll find NATIONAL TANK COMPANY listed in the white pages of your telephone book.*



*National Supply Co.
Export Division
New York City

*National Sales Co.
in California

It's National®

NATIONAL TANK COMPANY

DRAWER 1710
TULSA, OKLAHOMA

SURROUNDED BY....

SERVICE

Main Service Headquarters

PAMPA, TEXAS

Day Phone MO 4-3277

Night Phone MO 4-3270

Field Service Directory

Oklahoma
Tulsa WE 9-6381
Seminole 2437
Lindsay PL 6-2217

Texas
Pampa MO 4-3277
Odessa EM 6-3696
Houston OL 4-8961

Kansas
Great Bend GL 3-5331

South America
Anaco, Ven. 86-239

New Mexico
Hobbs EX 7-1822
Farmington DA 5-3862

Rocky Mountains
Casper 2-5748

California
Long Beach GA 7-9594

Canada
Edmonton 4-4453

CABOT, FRANKS SERVICE CENTERS ARE WHERE YOU NEED THEM . . .

Near You!

CABOT — PAMPA, TEXAS — OIL FIELD PUMPING EQUIPMENT

FRANKS — WELL SERVICING AND DRILLING UNITS — DIVISION, CABOT SHOPS, INC. — PAMPA, TEXAS

YOU GET "PRODUCTION-PROTECTION"...

when you use

HALLIBURTON CEMENTING TOOLS

Halliburton engineered and "well-qualified" tools . . . in field after field . . . well after well . . . contribute to the better cementing necessary to help provide future *production-protection* for your wells.

HALLIBURTON SELF-FILL DIFFERENTIAL COLLAR . . . engineered to fill casing automatically. Used specifically with Halliburton Super Seal Floating equipment for greater speed and safety as it is run into your well.

Only one Fill-up collar is required for each casing string!

Self Fill Differential Collar offers these important advantages:

- Reduced running-in time
- Minimizes plugging, even when drilling mud contains high percentage of foreign matter
- Effective even in the deepest wells
- Circulation is established downhole without tripping valve
- Flushes float valve of cuttings and settlings—reducing low pressure area below shoe

- **Here's a real advantage!**

No other differential fill-up equipment on the market continues to operate after circulation is once established . . . While running casing, circulation can be established at intervals, and the Halliburton Self-Fill Differential Collar will continue to function until it is sheared by bottom plug or by dropping a ball.

Super Seal Float Collar

HALLIBURTON SUPER SEAL FLOAT COLLAR . . . Used in conjunction with the Self-Fill Differential Collar, helps prevent blowouts by eliminating low pressure areas. These companion-tools will not restrict the downward flow of fluids when casing is raised. Float Valve assembly is held in place with special shock resistant concrete with high shear and compressive strength. Under normal drilling conditions, no "drilling-out" difficulty is present.

Turbo Jet Float Shoe

HALLIBURTON TURBO-JET FLOAT SHOE . . . for Maximum Dependability. Agitates and distributes cement by powerful self activating built-in rotor which forces a jet-stream of fluid through side ports and bottom—minimizing channeling and giving more uniform cementing around casing.

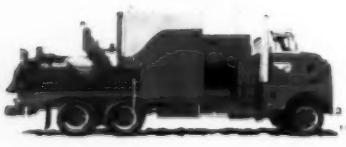
Turbulent action "jets" off and washes mud cake from bottom and sides of hole, prior to cementing, substantially reduces contamination. Equipped with back pressure valve which helps assure maximum dependability even in deep-hot holes. All parts are drillable.

Put the advantages of these Halliburton *"production-protection"* tools to work in your well . . . and for additional information about other Halliburton field-proven products that help successfully cement your well . . . call your Halliburton Representative.

"284 Service Centers—Just Minutes Away From Your Wells"

HALLIBURTON CEMENTING SERVICES

HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA



"CONTINUE TO LOOK TO HALLIBURTON — FOR LEADERSHIP"

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Of Things To Come . . . In Oil

FRAC TRUCKS WILL BE RATED BY HYDRAULIC HORSEPOWER rather than by horsepower of engine driving pumps. An API committee (RP number not yet assigned) is working out final draft of ratings for approval. Hydraulic horsepower ratings, necessary to calculate pump truck needs for a fracturing treatment, were previously figured by making individual conversions from pump data, although rated engine horsepower was known. New rating standard should aid engineers in designing fracture treatments.

INCREASED USE OF AIRCRAFT IN OFFSHORE SEISMIC WORK is to be noted as a result of "major breakthrough in oil exploration techniques" involving the use of amphibian planes and helicopters. Use of two Catalina flying boats in the Bay of Bengal (Indian Ocean) permitted completion of 5000 seismic records as against 3000 anticipated in the same amount of time. Seismic records are produced by detonating charges about a mile aft of the aircraft, the shock waves registering on instruments in the aircraft.

ARGENTINES TO CALL FOR MORE AID in helping its government-owned oil company to develop oil resources. The organization, YPF, which just recently announced that Southeastern Drilling and Kerr-McGee Oil Industries would drill 1500 wells in Comodoro Rivadavia, has called for bids for exploration, development and exploitation in several new zones. YPF will open bids July 2 to award concessions on the 30,000 sq km tracts. As added incentive, YPF is giving to interested companies all available geological and geophysical, drilling data, drawings, charts and maps. This is another phase in Argentina's concerted effort to make the country self-sufficient in oil.

SLOWER, BUT CONSTANT, RATE OF OIL DEMAND GROWTH during the next 20 years is predicted by Humble's president, Morgan J. Davis. As a result, Davis says, "The amount of effort (drilling and development) required to develop new resources to replace production and increase reserves will not increase as rapidly as in the past . . . But a 3 percent annual increase in oil consumption (will call for) 3 or 4 billion bbl annually of gross new reserves . . . The prospect that the domestic industry can develop during the next 20 years about three-fourths as much new oil as it has in its first century is certainly not a gloomy outlook."

BOLD PRODUCTION ESTIMATES FOR LOUISIANA are being tossed around in the Pelican State. According to Robert U. Blum, president of Creole Explorations, Louisiana will be the nation's leading oil and gas producer by 1967, based on offshore as well as land drilling activities. Texas now leads Louisiana in production at a ratio of 5 to 1, but says Blum: "There is expert opinion that on the basis of acre-feet of reserves, Louisiana is in first place now."

For extra high *strength wire rope...*

use CF&I-Wickwire *Double Gray*

The CF&I Image reflects CF&I's experience as a producer of many steel products and CF&I's versatility in developing new products to meet exacting requirements . . . like Wickwire Double Gray*.

The special steel used in Double Gray provides extra resistance to the deforming effects of peening and crushing which occur on the drums and sheaves of heavy equipment. Double Gray also gives extra resistance to abrasion.

Because of these superior qualities, Double Gray rope quickly repays its slightly higher initial cost in safer, more economical operations. Use it wherever extra high strength wire rope is required.

For a free copy of our Double Gray booklet, write to: Advertising Department, The Colorado Fuel and Iron Corporation, 575 Madison Avenue, New York 22, N. Y.

**Wickwire Double Gray Wire Rope is made of extra-improved plow steel. Fortified by an independent wire rope core of the same extra high strength steel, Double Gray rope has a 15% higher breaking strength than the catalog breaking strength of an improved plow steel rope with IWRC.*

WICKWIRE ROPE

THE COLORADO FUEL AND IRON CORPORATION

In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque · Amarillo · Billings · Boise · Butte Denver · El Paso · Farmington (N.M.) · Fort Worth · Houston · Kansas City · Lincoln · Los Angeles · Oakland · Odessa (Tex.) Oklahoma City · Phoenix · Portland · Pueblo · Salt Lake City · San Francisco · San Leandro · Seattle · Spokane · Tulsa · Wichita

In the East: **WICKWIRE SPENCER STEEL DIVISION**—Boston · Buffalo · Chattanooga · Chicago · Detroit · Emlenton (Pa.) New Orleans · New York · Philadelphia

6632

CF&I STEEL

D&S First in . . .

1947 1952 1956

Diamond Drilling

EVOLUTION

Spearheaded by D&S–TRUCO

During the past 10 years many new principles have evolved to change the design and performance of diamond drilling and coring bits. Through this era the industry has looked to D&S for leadership.

With the introduction of the now famous TRI-DIA bits, D&S scored a major industry advance. Now, through research D&S brings you the all new TRI-Y jet action diamond drill bit . . . custom designed to give faster penetration, eliminate re-grinding center, last longer and give more overall rig savings.

WRITE OR CALL TODAY! Your D&S sales engineers will call on you and explain this revolutionary new Diamond Bit.

TRI-Y Standard recommended for extremely hard abrasive formations. Reduced Face TRI-Y recommended for sands, shales under pressure compaction.

DIAMOND DRILLING EQUIPMENT

6210 NORTH CENTRAL EXPRESSWAY | DALLAS, TEXAS

OFFICES IN ALL PRINCIPAL OIL AREAS

Ultra Fine Diamond Equipment for the Oilfield

TRUCO DIAMOND BITS

Drilling & Service INC.

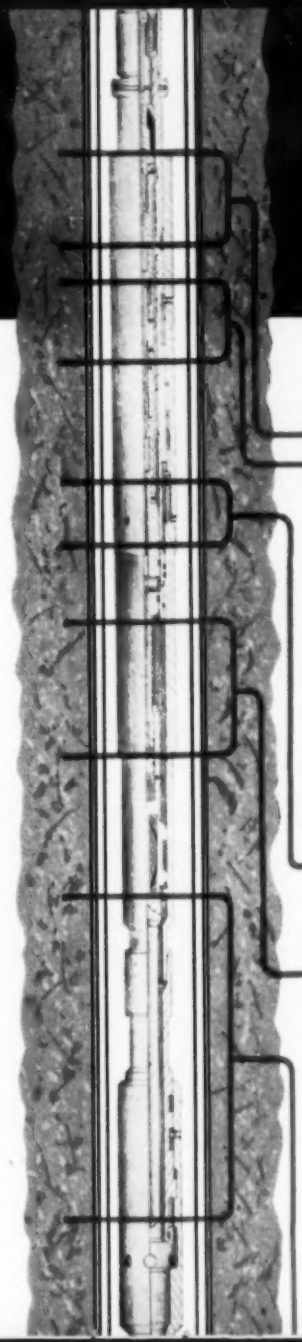
World-Wide in Scope — Local in Know How and Service

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

NEW

JOHNSTON TESTERS FULL-BORE TEST AND COMPLETION TOOL

Now, you can make all the savings in round trips and rig time that result from using a combination test and completion tool without the disadvantages that sometimes result.



NEW

THE UNIQUE LOCKING SYSTEM makes it possible for the testing valve assembly to hold pressure in either direction; therefore, tubing or drill pipe may be pressured-up at any time while going in the hole without the use of any additional equipment.

TEST VALVE IS EASY TO OPEN—Simply pick up on tubing, torque slightly to the right and set down. The action is positive and there is no chance of "getting lost" by extensive rotation.

VALVE SYSTEM OFFERS MANY ADVANTAGES—**First,** initial shut-in pressure can be taken very quickly with only a minimum flow of formation fluid. **Second,** since the test valve closes before the circulating valve opens, mud from the annulus cannot contaminate the formation. **Third,** valuable rig time is saved because you can reverse circulate while taking shut-in pressures. This "circulating" feature also keeps sediment from collecting on top of the testing valve assembly for easy retrieving.

EXCLUSIVE JOHNSTON TESTING VALVE ASSEMBLY is rugged and dependable. Because of the valve arrangement and the recording assembly, you can take as many bottom hole shut-in pressures as you want without returning test section to surface. This means more information from your test. Later tests may be made by simply pumping the test section back in place.

***No rotation is necessary* with this tool during drill stem testing operations.**

You can take as many bottom hole shut-in pressures as you want without returning the testing valve assembly to surface.

You can also squeeze cement, re-perforate, fracture or acidize without ever pulling the tubing or drill pipe.

Then, if you need later tests, you can pump the pressure test section in place without ever making a round trip.

You can do all these things with full assurance that you are using a positive tool that is completely safe in operation. There is no guesswork. All operations involve simple up-and-down movement or a minimum of right hand rotation. No damage results from excessive rotation. No left hand rotation is ever required.

After all operations are completed, a built-in jar assures packer unseating when unseating is desired.

In addition, this tool is backed by Johnston Testers —the largest operator in the field of drill stem testing. You get all the advantages of Johnston's unparalleled experience when you specify the *Johnston* Test and Completion Tool. Fill out the coupon or drop us a note on your letterhead for full information. Please refer to bulletin number A.62

Please send me complete information on the New Johnston Full-Bore Test and Completion Tool.

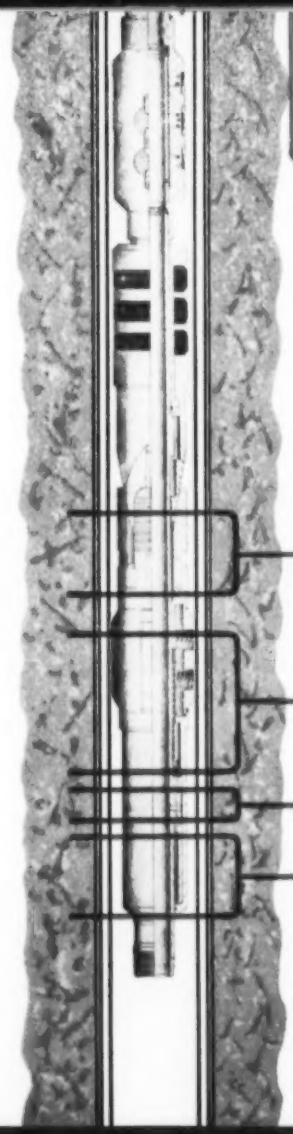
NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

A.1



JOHNSTON TYPE "T" PRESSURE RECORDER gives unfailing accuracy, sensitivity and dependability under all testing conditions. This recorder is built to withstand unavoidable oil field jolts and is not apt to be knocked out of calibration. Non-tension type recorders may.

TWO-WAY ANCHOR SLIPS enable the operator to take a strain on the tubing without unseating the packer.

BUILT-IN JAR makes it easy to unseat packer. As in all other operations, no left hand rotation is required to operate or reset.

SIMPLE SETTING OF PACKER. Just pick up, torque to the right and slack-off, and the packer is set. The by-pass valve, which is closed when the packer is set, has a simple and positive opening and closing action.

FULL OPENING THROUGH TOOL (when testing valve assembly is out) permits perforating, squeezing, and other operations without difficulty.

PATENTS APPLIED FOR

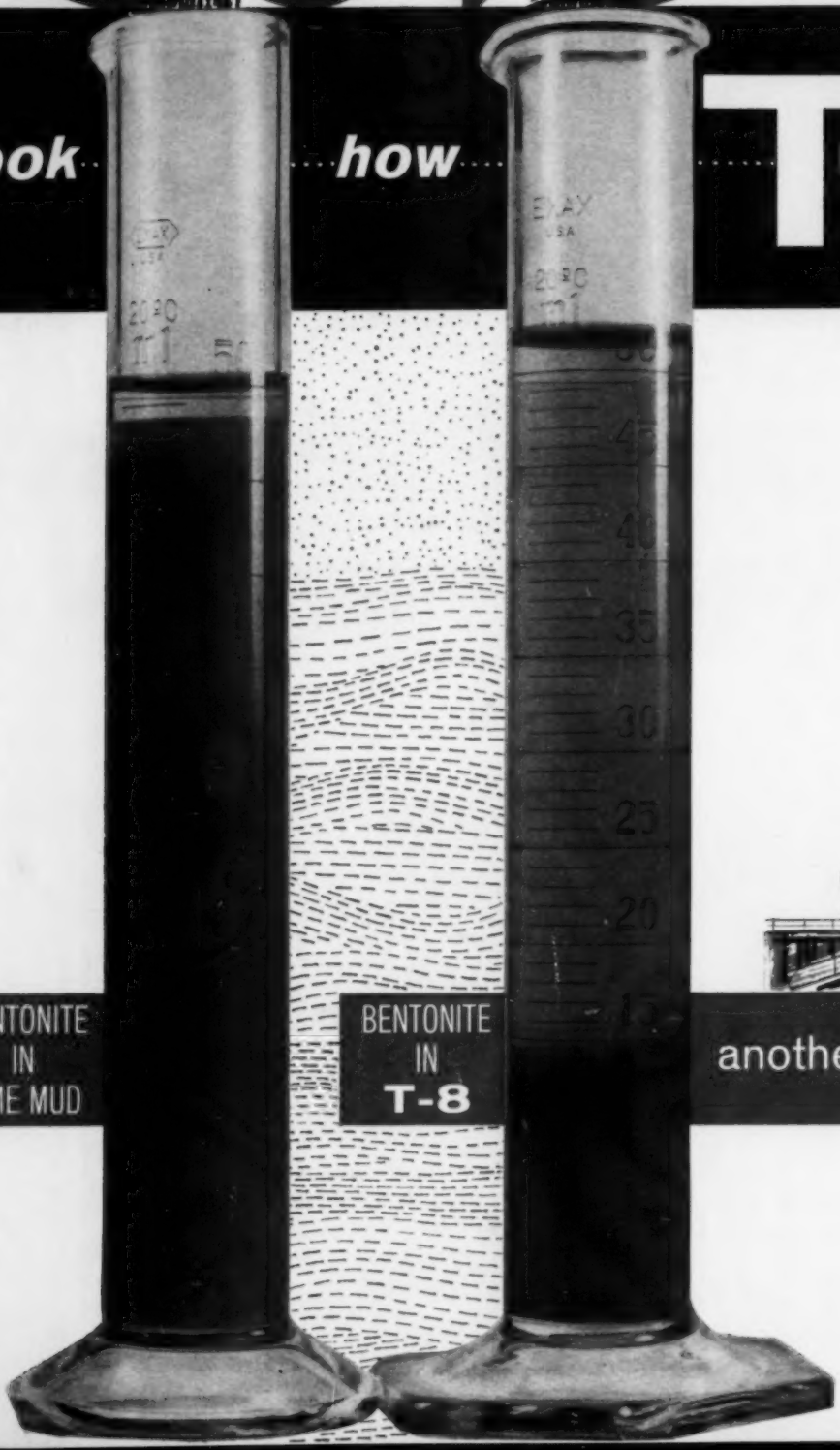
JOHNSTON TESTERS, INC.

P. O. BOX 98

HOUSTON 1, TEXAS

well a,b well

Look how T-8



another *well done*

....and Magcobar engineering cut mud cost on well

NEW ORLEANS AREA

	depth	type mud	weight mud	cost of mud
a	13,600 ft.	Lime	15.6 lb./gal.	$130,000
b	13,590 ft.	T-8	15.6 lb./gal.	$ 65,000

All along the Gulf Coast, savings have been substantial using T-8 instead of other muds in drilling shale formations. The secret of T-8, as the graduates to the left show, is that it reduces the hydration and dispersion of solids, minimizing the build-up of formation solids in the mud system.

With other muds, shale solids become part of the drilling fluid, increasing the viscosity. Water, added to reduce viscosity, lowers the mud weight, and new barite must be added. The additional barite and water increase the volume, so that expensive mud is jetted. With T-8 you can maintain good mud properties with less jetting, less barite, and at impressive savings.

The successful field performance of T-8 confirms Magcobar's basic approach to drilling fluid problems: Developing better products to solve specific drilling problems, and training better mud engineers to insure the highest level of performance from these products.

T-8 is only one of Magcobar's many answers to the problem of high drilling costs. The right products *used right* by Magcobar can cut costs on your next well, too.

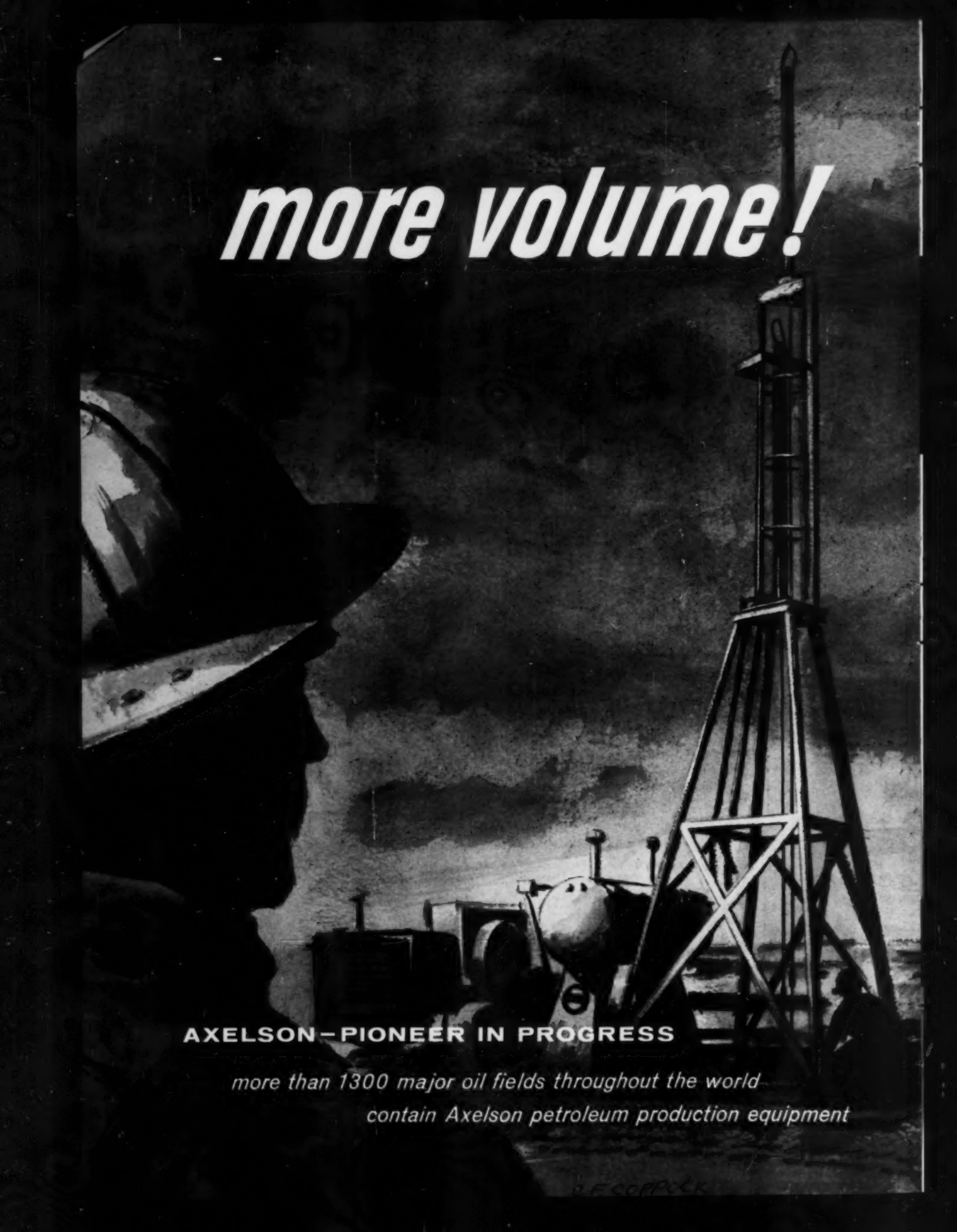
Wherever your drilling operations, you can use Magcobar engineering and products. There are more than 500 stockpoints in the U.S. and Canada. Elsewhere, write Foreign Operations, P. O. Box 6504, Houston, Texas.

with Magcobar Technology

MAGNET COVE BARIUM CORPORATION

Houston

Magcobar
Complete
DRILLING MUD SERVICE


more volume!
AXELSON—PIONEER IN PROGRESS
more than 1300 major oil fields throughout the world
contain Axelson petroleum production equipment

NEW FOR DUAL COMPLETIONS

AXELSON DUO-HYDRAX

Axelson's new DUO-HYDRAX offers a new method for dual zone production. It is simple, flexible, economical, and has all the advantages of hydraulic pumping. It incorporates many advantages of the two major dual zone pumping methods currently employed, and eliminates some of their disadvantages.

Dual zone pumping is accomplished at present by either (1) a special subsurface pump operated by a single sucker rod string, or (2) two independent beam-actuated sucker rod strings each operating a standard subsurface pump. The latter method requires two mechanical pumping jacks placed in line with the horseheads opposed, often resulting in personal hazard in the well-head area.

DUO-HYDRAX offers these distinct advantages:

- **an Axelson double piston surface hydraulic pumping unit reciprocates two sucker rod strings at different depths, each of which operates a standard subsurface pump;**
- **one base supports all equipment;**
- **a single reservoir supplies hydraulic fluid to two separate hydraulic circuits;**
- **separate hydraulic circuits permit separate cycle rate for each zone;**
- **Hydrax speed maintains smooth pumping rate (means less rod wear);**
- **available for stroke lengths of 4, 6, and 10 feet of polished rod travel;**
- **flexibility allows such installations as a 4 foot stroke for one zone and a longer stroke for the other.**

Write today for more information concerning the DUO-HYDRAX and your dual zone pumping requirements.

COMPLETE HYDRAX SERVICE

Axelson Hydrax Field Servicemen are located throughout the oil fields to serve users of Axelson Hydrax Pumping Units, single as well as dual. This on-the-spot service means lower maintenance costs and more profitable production runs.

USI Axelson

DIVISION OF U. S. INDUSTRIES, INC.
6160 S. BOYLE AVENUE • LOS ANGELES 58, CALIF. • LUdlow 7-1271

Copyright 1959—Axelson—Division of U.S. Industries, Inc.— AX-15-59

GIVE THEM YOUR TOUGHEST DRILLING ASSIGNMENTS...

Mid-Continent Rotary Tables are *BUILT TO TAKE IT!*

Mid-Continent Rotary Tables are engineered and designed to withstand high rotating speeds and heavy loads under the toughest drilling conditions. Manufactured by Mid-Continent Supply's subsidiary, Unit Rig & Equipment Co., these Mud-Proof rotary tables are constructed to provide maximum strength and rigidity with minimum weight. Only the finest parts go into the Mid-Continent table, assuring smooth, trouble-free operation.

Assembly of tables nearing completion shows grooving for triple labyrinth seal. They will be balanced electronically during final inspection to relieve vibration stresses on bearings and gear.

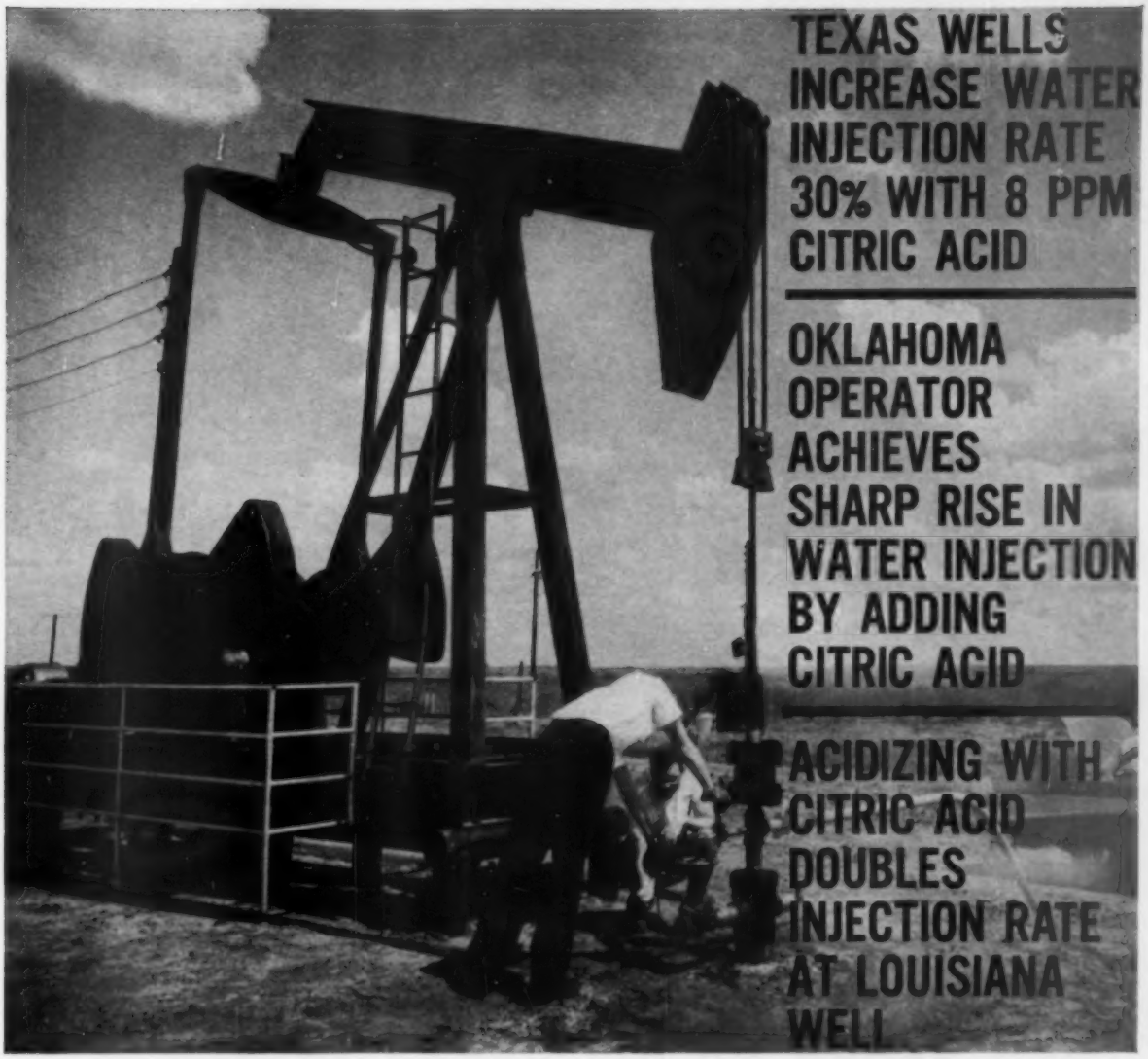
Mid-Continent Rotary Tables are available in four sizes: **S—17½-A Short; S—17½-A Long; S—21A Long; and S—27½-A Long. For complete information about these rotary tables or any item of drilling equipment, contact your nearest Mid-Continent representative.**

RT1-9

MID-CONTINENT SUPPLY CO.

MID-CONTINENT BUILDING • FORT WORTH, TEXAS
Export Division: 45 Rockefeller Plaza, New York 20, N. Y. Cable: MIDCUMPORT NYK

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY



TEXAS WELLS INCREASE WATER INJECTION RATE 30% WITH 8 PPM CITRIC ACID

OKLAHOMA OPERATOR ACHIEVES SHARP RISE IN WATER INJECTION BY ADDING CITRIC ACID

ACIDIZING WITH CITRIC ACID DOUBLES INJECTION RATE AT LOUISIANA WELL

• Citric acid is making news at water injection operations all over the country. Extensive tests carried out at well heads have proven this fact: citric acid can prevent plugging that is caused by iron precipitates in injection water.

At two salt water disposal wells in Southern Texas, with average injection rates of 200 to 400 barrels per day, maintenance treatment with an 8 ppm addition of citric was started. In a short time, a 30% increase in flow rates was noted.

A well in Oklahoma was experiencing lowered injection rates because of iron plugged sandface. The well was acidized with a solution of 260 pounds of citric acid, 25 gallons of Triton* X-100, 250 gallons of 15% HCl and 500 gallons of water. This treatment dissolved and sequestered iron responsible for plugging. Injection rate rose from 50 bbl water per day to 400 bbl per day at considerably reduced pressures.

A water flood operation in Southern Louisiana had such a concentration of iron precipitates that they could not, economically, be kept in solution. Two wells were treated with two 400 pound batches of citric acid each, two weeks apart. Combined injection rates more than doubled, from 4,000 to more than 8,500 barrels per day, at last report. Also, the injection pressure has averaged 300 psi lower than previous requirements. These results were better than any previously obtained with hydrochloric acid treatments.

Other operators using citric acid have noted good results because of less frequent downtime on filters, and less replacement of parts because of rusting.

If you have been experiencing problems caused by iron precipitation in your injection water, write Pfizer for full information on the use of citric acid for iron sequestering.

*registered trademark Rohm & Haas Co.

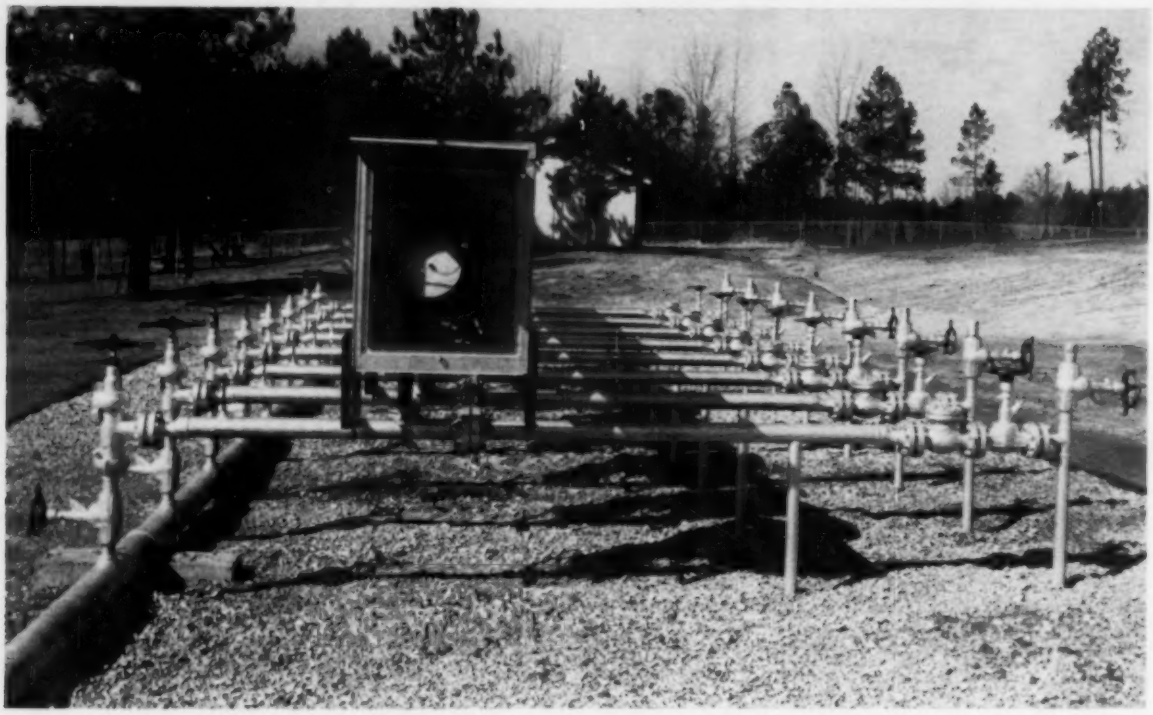
Science for the world's well-being

Pfizer

Manufacturing Chemists for over 100 Years

CHAS. PFIZER & CO., INC.
CHEMICAL SALES DIVISION
630 Flushing Ave., Brooklyn 6, N.Y. Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Texas; Montreal, Canada

SO MANY EXTRA YEARS OF SERVICE WHEN YOU CHOOSE ORBIT VALVES



Orbit Forged Steel ASA Class Valves installed in a gas separation facility located near Gibsland, Louisiana

ASA CLASS OR API CLASS VALVES . . . QUALITY & SAVINGS ARE ALWAYS IN ORBIT!

Dollar savings can be realized by specifying Orbit Forged Steel ASA Class Valves, where possible, in field production piping such as shown in the above photo. Orbit ASA Valves are priced considerably under API rated Orbit Forged Steel Production Valves — which are, of course, competitively priced with other makes of production valves. There are other installations, too, where ASA rated Orbit Valves can be used in production piping — such as meter runs, manifolds, water flooding, gas gathering systems.

Our industrial sales and production sales departments will be glad to make recommendations for the service or services you have in mind — whether your requirements are for ASA or API rated valves.

WRITE FOR CATALOG 58-B COVERING ASA CLASS VALVES OR CATALOG 58-A COVERING PRODUCTION VALVES.

OIL'S FIRST CENTURY
BORN IN FREEDOM
WORKING FOR PROGRESS

ORBIT VALVES

ORBIT VALVE COMPANY

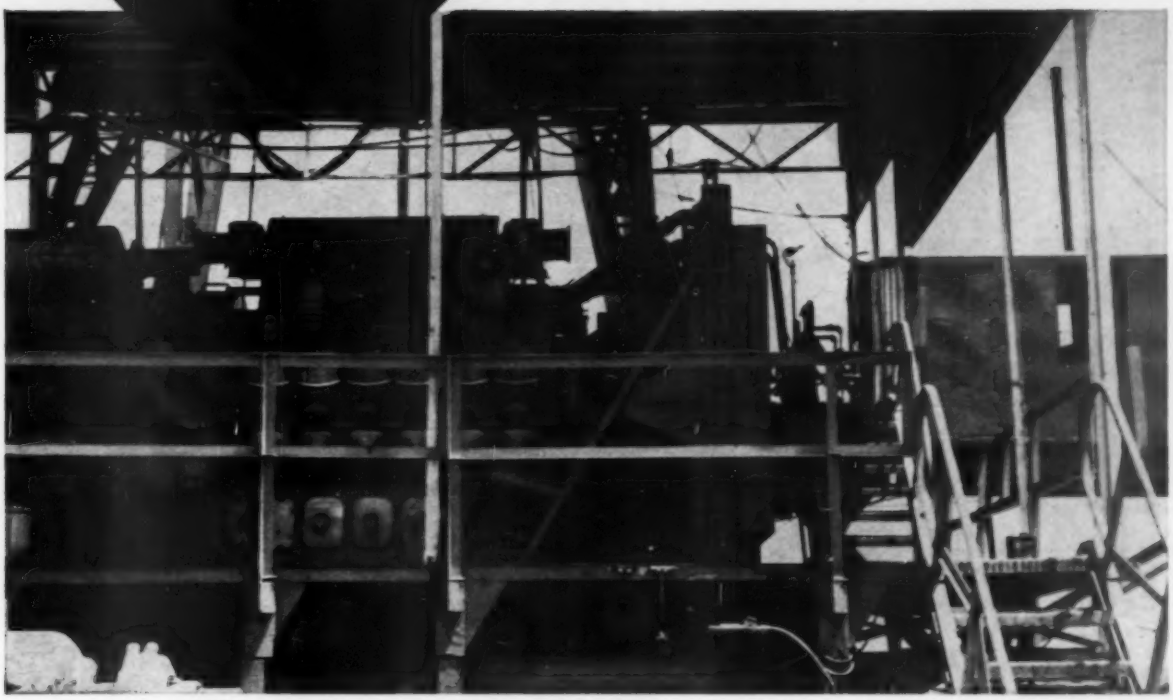
P. O. BOX 699, TULSA, OKLAHOMA, Phone LUther 4-4761, TWX TU 925
WAREHOUSES: HOUSTON, TEXAS, 407 Velasco, CApitol 8-6623, TWX HO 115; ODESSA, TEXAS, 402 West County Road, FEderal 7-2263, TWX ODESSA TEX 8706; LAFAYETTE, LOUISIANA, 3111 Cameron St., CEnter 4-3326; CASPER, WYOMING, 414 South Elm Street, Phone 2-1324; EDMONTON, ALBERTA, CANADA, 7119-104th St., Phone 391-283. WEST COAST REPRESENTATIVES: Charles Lowe Company, 383 Fourth Street, San Francisco, Calif.; Marshall E. Niedecker Company, 2785 Cherry Ave., Signal Hill, Calif. CANADIAN REPRESENTATIVES: T. R. Pickford & Company, Ltd., Calgary, Alberta, 309 7th Avenue West; Amherst 2-7371. EXPORT REPRESENTATIVE: New York 36, N. Y., 500 Fifth Avenue, BRyant 9-2236.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

ROILINE ENGINES

(Formerly LE ROI)

for more power per fuel dollar



Shell Oil Company Rig No. 14 at Lovington, New Mexico—powered by three L-3460 Roiline gas engines—3468 cu. in. displ., V-12 cylinders, 7¼-in. bore x 7-in. stroke—each 570 max. hp. at 1350 rpm.

All-around dependability : : : with the high acceleration so important in drilling . . . is combined with high fuel economy, low upkeep and long service life in Model L-3460 ROILINE engines. It's largely a matter of design. Design that's basically simple . . . always modern, because it's constantly being improved to meet the oil fields' changing needs. Among the ROILINE advantages are full length guided valve stem mechanisms, light weight cam ground aluminum pistons, precision bearings, full flow oil filters, sectional water-cooled exhaust manifolds, large main bearings, full pressure lubrication, and other big features. For details send for Bulletin E-7A.

ARIZONA, Casa Grande, Engine Service Company, Inc.
ARKANSAS, Paragould, Wonder State Manufacturing Co.
CALIFORNIA, Long Beach, Engine & Equipment Company
COLORADO, Denver, Emrick & Hill Engine & Equipt. Co.
ILLINOIS, Centralia, John Nickell Company
KANSAS, Garden City, Carson Machine & Supply Co.
LOUISIANA, Shreveport, Ingersoll Corporation
MICHIGAN, Reed City, Hafer Engine Company
OHIO, Columbus 19, Cantwell Machinery Company
OKLAHOMA, Chickasha, Chickasha Gin & Mill Supplies
Oklahoma City 9, Carson Machine & Supply Co.
PENNSYLVANIA, Pittsburgh 34, P. C. McKenzie Company
TEXAS, Houston 1, Southern Engine & Pump Co.
Lubbock, Farmers Supply Company
Odessa, General Machine & Supply Co.
Wichita Falls, Nortex Engine & Equipment Co.
WYOMING, Casper, Emrick & Hill Engine & Equipt. Co.

• The trade mark LE ROI is used under license from Westinghouse Airbrake Co., the trade mark owner. 427

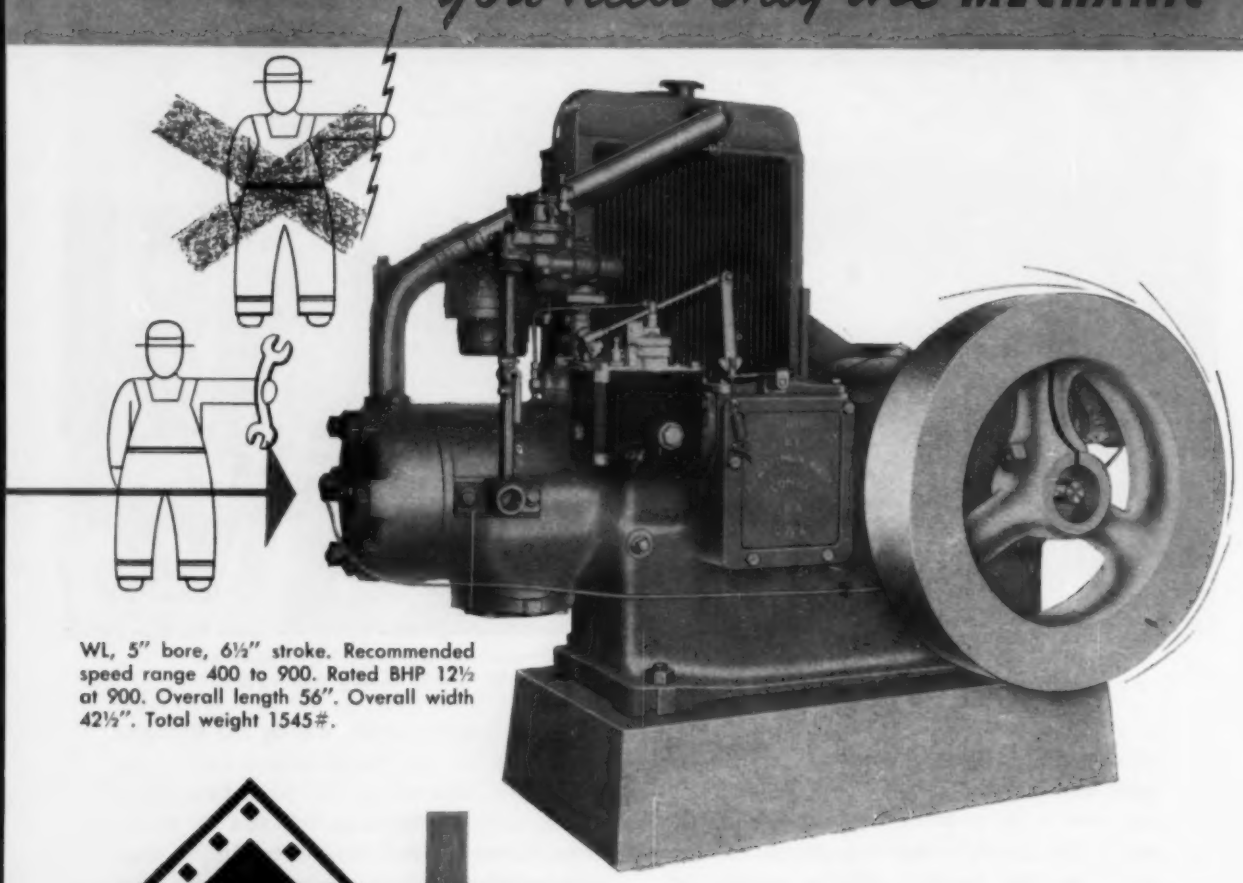
WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN / New York • Tulsa • Los Angeles
Factories: Waukesha, Wisconsin and Clinton, Iowa

Why two men to do one man's job?

with Electrified Equipment { 1-ELECTRICIAN / 2-MECHANIC

with **AJAX GAS ENGINE**

You need Only the **MECHANIC**



WL, 5" bore, 6½" stroke. Recommended speed range 400 to 900. Rated BHP 12½ at 900. Overall length 56". Overall width 42½". Total weight 1545#.

AJAX ENGINES

AJAX GAS AND OIL ENGINES

AJAX also builders of

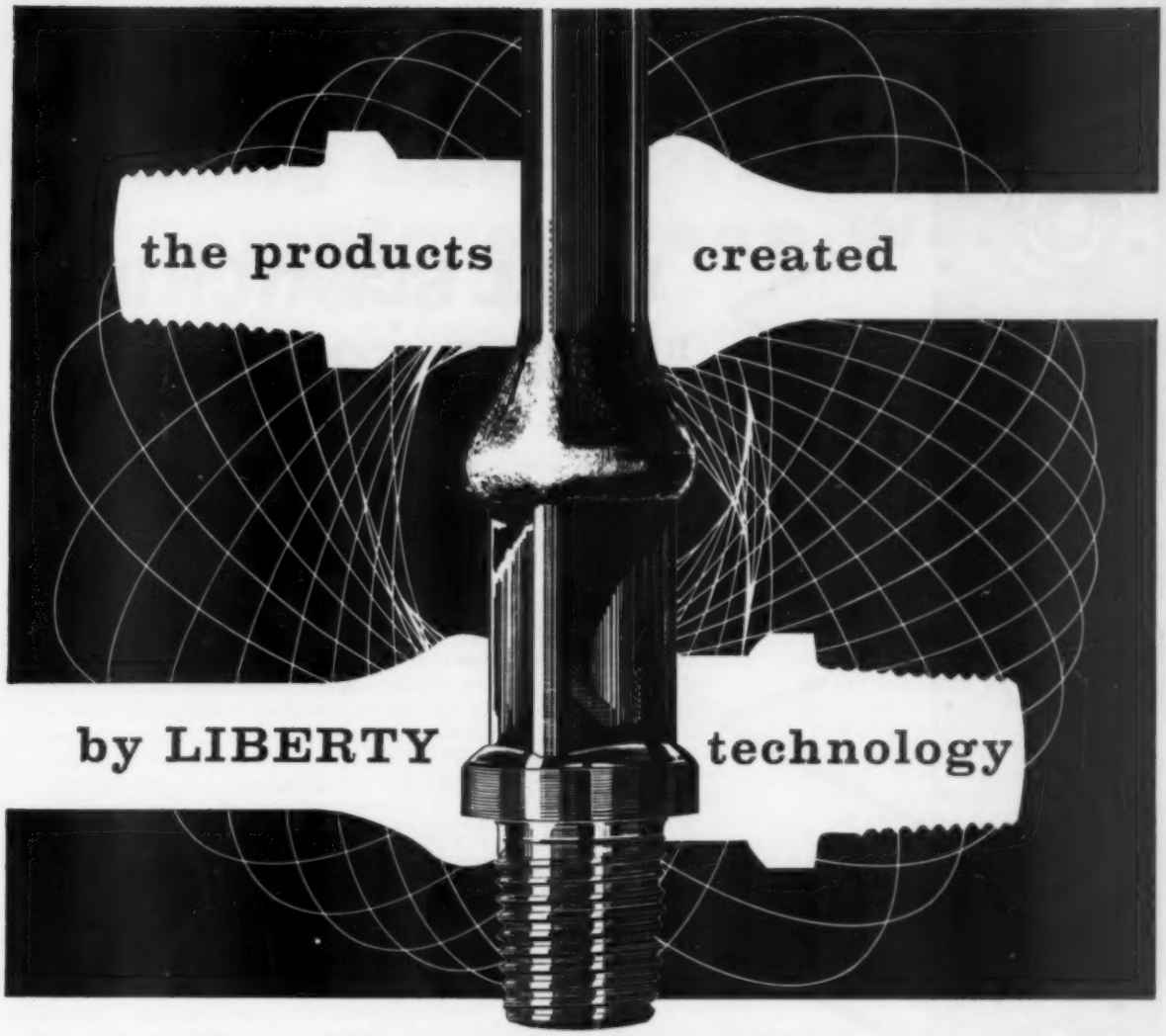
Compressors

Pressure Pumps

AJAX IRON WORKS CORRY, PENNSYLVANIA

OIL FIELD DISTRIBUTORS

- The National Supply Company, Pittsburgh, Pa.
- R. B. Moore Company, Bolivar, N. Y.
- Bethlehem Steel Company — Supply Division, Tulsa, Okla.



Daily Show Their EXCELLENCE in the Field

Save 10% to 33⅓% on pumping from low fluid-volume wells to 5,000 feet, with the LIBERTY ½-INCH SUCKER ROD – the newest product of LIBERTY technology.

To get complete information on the LIBERTY ½-INCH SUCKER ROD, send today for technical information.

All LIBERTY products are sold only in Supply Stores, through the LIBERTY SERVICE NETWORK.

There are many reasons for the excellence of LIBERTY SUCKER RODS and PUMPING UNITS but there is only one final proof: the performance which LIBERTY products give in day after day of hard field use.

In this way, LIBERTY SUCKER RODS and PUMPING UNITS have been serving the oil production industry for over 40 years, in every kind of pumping condition.

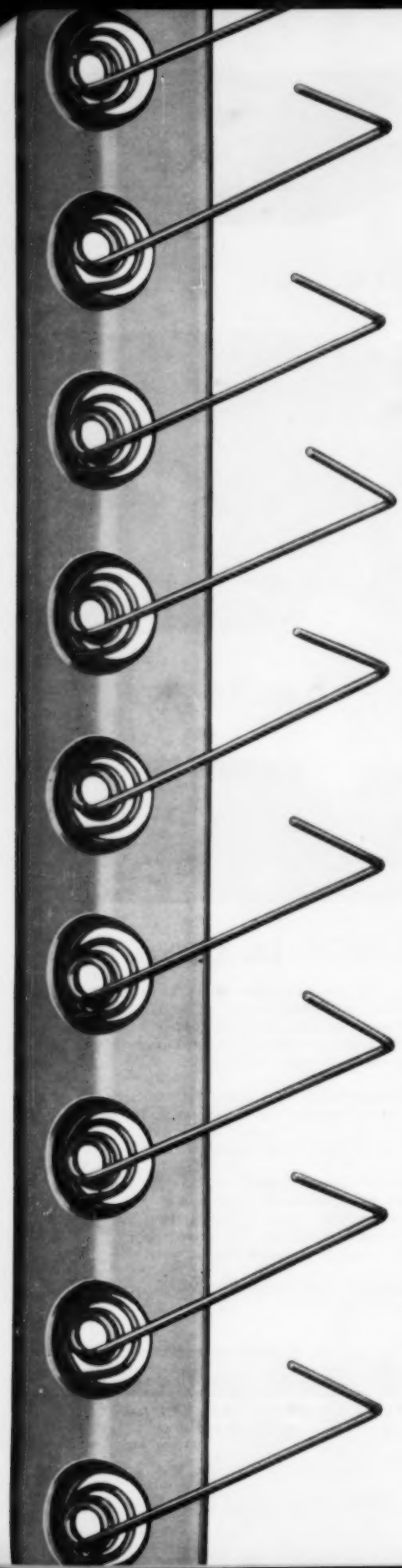
LIBERTY Field Representatives bring the same quality of excellence, in their training and experience, to assist you in designing installations for maximum efficiency in your pumping operations.

To learn more about LIBERTY products and services, write or call –

MANUFACTURING COMPANY OF TEXAS

4025 HEMPHILL STREET • FORT WORTH, TEXAS

LM-5



is WALL SCRATCHING "POINTLESS?"

NOT WHEN YOU USE Baker ROTATING Wall Scratchers

WITH "PLOW ANGLE" WIRES!

Operators who prefer "Rotating-Type" Scratchers will find the new Baker *ROTATING* Wall Scratcher (Product No. 903) far more effective than typical scratchers with "pointless" trailing wires. See in Fig. 1, how the right-angle bend at the ends of the wires in Baker *ROTATING* Scratchers provides a "plow angle" point which *must* dig in and effectively remove mud cake. Compare these results with the "pointless" action of trailing wires which are *merely dragged over* the mud cake without removing it; see Fig. 2.

Note also in Fig. 3, how the "plow angle" scratching point is maintained over a wide range of clearances—even under slim hole conditions—as each wire automatically adjusts to meet the wall of the hole.

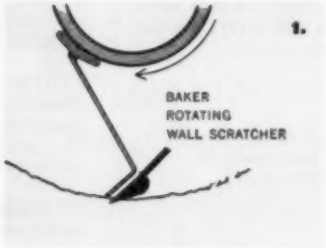
Shock absorbing spiral springs, mechanically held by the *double* body thickness, prevent distortion of the scratcher wires both while running-in the hole and throughout the scratching operation.

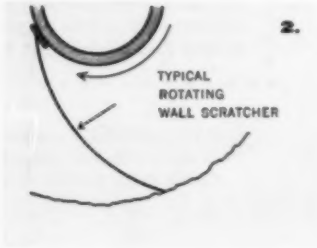
Ask the Baker representative in your area for details of spacing and installation. Try this successful aid to "first-time" cementing.

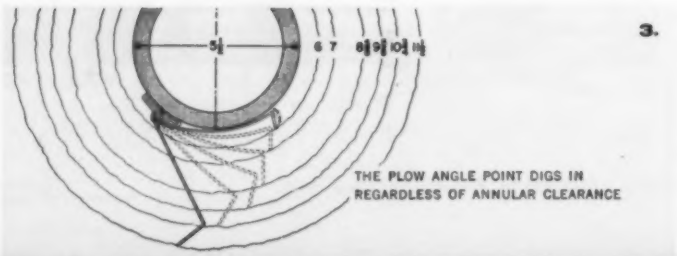
If you prefer RECIPROCATING *Type Wall Scratchers, Baker Solid-Ring* SLIP-ON *Scratchers, or Baker* HINGE-LOK *Wall Scratchers will bring you* CONTROLLED SCRATCHING *by removing the mud cake only throughout the area to be cemented.*

BAKER OIL TOOLS, INC.

HOUSTON / LOS ANGELES / NEW YORK







Trinidad:

Floating Barge Drills, Tests, Completes Deep Well

Dominion Oil, Offshore Company set new records at 11,387 ft Gulf of Paria test

DOMINION OIL LTD., which has been drilling deep exploratory wells from a floating platform in the Gulf of Paria off the west coast of Trinidad for more than a year, has established several new records at its latest test.

Dominion Oil has set a new depth record for drilling from vessels of its type with a total depth of 11,387 ft on its fourth well. The company has successfully drillstem-tested the well, and now it has completed the well and run production tests — all from the floating barge.

Dominion Oil's first three exploratory wells drilled from the floating drilling platform were dry.

The No. 4 well, following a 24-hour production test, was killed with heavy mud and plugged with a retrievable plug and a Christmas tree put on top of the casing at the ocean floor. The floating barge, with The Offshore Company as drilling contractor, has moved to its next location.

Each new well using the floating platform has been drilled with steadily increasing efficiency. Although the speed of drilling the holes has not been spectacular in comparison with conventional methods, drilling costs have now been reduced until they are considerably less than more conventional marine drilling costs and several holes have exceeded the widely advertised records for this method of drilling.

Dominion broke its own record at its newly completed well, some 25 miles southwest of Port of Spain. This latter hole is believed to be the deepest yet drilled from *any* platform in the Trinidad part of the Gulf of Paria.

California Pattern

In June 1957, Dominion Oil agreed with its parent company, Standard Oil Company of California, that success with a floating ship (the Western Explorer) off the California Coast had been sufficient to justify the use of a similar vessel for drilling medium depth exploratory slim holes in the Gulf of Paria.

The Offshore Company was selected as the drilling contractor and their barge was equipped with six 6000 lb anchors, two cranes, blowout preventer hose reels, and constant tension devices for the submarine guide lines. A 12-ft diameter well was cut in the center of the barge, which is 248 ft long, 72 ft wide, and 15 ft deep. After the barge was towed from New Orleans to Trinidad, a drawworks was installed and rigged up in a conventional manner.

The 131 ft mast was originally shortened to 100 ft and provision was made to lay down 3½-in. drillpipe in doubles. A gimballed rotary bushing was used, block guide cables were installed and the barge was ready for its first location in September 1957. Submarine drilling control equipment has been used since the beginning of the program.

Racking Trebles

The drilling program and the equipment have been constantly modified and improved to suit conditions in the Gulf of Paria. The mast has been lengthened to the original 131 ft and reinforced in order to stand back all the drill pipe in trebles (90 ft lengths), 4½-in. drill pipe is being used to drill conventional size holes to about 9000 ft where 7-in. casing is generally run and 3½-in. drillpipe used for further drilling. A drill nipple has been added with the necessary motion compensating devices and block guide rails have replaced the original cables. The constant tension devices are rarely used although they are still installed.

Bumper Subs and 14-ft Swells

Holes have been drilled in water depths ranging from 36 to 106 ft and weather conditions have ranged from dead calm to 14 ft swells. The larger swells are extremely rare and drilling is not attempted during these periods although other operations can continue. By using additional bumper subs in the drill string and a recently designed drilling nipple soon to be installed, Dominion hopes to have the ability to continue drilling in at least 10 ft swells.

All operations are affected to some extent by the constant movement of the barge and drilling equipment with respect to the hole being drilled. A self-actuating compensating device has been installed to keep wire line tools stationary with respect to the hole. Three successful fishing and washover jobs have been completed to date without undue difficulty that could be attributed to barge movement. As much as 5000 ft of 4½-in. drillpipe and 7-in. drill collars were washed over and recovered in five days on one

occasion. It is not possible to use some special tools (such as tension operated outside cutters) and tool selection must always be made considering the complications due to barge movement.

Drillstem Tests

High quality oil was produced during a recent test at its fourth hole in the Gulf of Paria. Because of the high pressures involved, and the fact that floating equipment was used to make the test, many extra safety precautions were undertaken and the test was discontinued after less than 24 hours. It was therefore impossible to determine whether or not commercial oil production had been discovered.

However, the results obtained were sufficiently encouraging to warrant completing the hole as a producing well and conducting more extensive production tests. This had never before been attempted on a well drilled from a floating platform.

After final logs were run, a cement plug was set, and a 5-in. liner hung in the 7-in. casing, which had previously been set at 9350 ft. The liner was cemented at 10,702 ft. Approximately 1500 ft of 3½-in. drillpipe was also cemented in above the liner due to premature setting of the cement. Drillpipe was recovered to top of cement.

A production packer was set immediately above the drillpipe fish. Tubing was then run, and a section of the liner was successfully perforated using a swing jet gun.

Blowout preventers were removed and completely checked and tested. After being replaced, the 7-in. casing was retested. Since this was the first test from a floating barge, everything possible was done to ensure the safety of equipment and personnel.

A testing barge with a heater, separators and tanks was moored alongside the drilling barge and the production lines hooked up with high pressure, flexible, steel hose.

Special high-pressure tubing was run and each connection hydraulically tested. The tubing was suspended in a tubing hanger at the ocean floor and a high-pressure Christmas tree installed and tested. The tubing was landed so that the tree was well above the derrick floor. This allowed the barge to move independently of the tubing and tree, which remained stationary. Safety valves were put on the tree which would shut in the well in case a surface connection failed. The well was brought in, and a day long production test was run.

Plans are now underway to set a protective jacket over the location and extend casing strings and tubing above the surface of the Gulf. The well will then be brought back on production and extensive tests conducted. * * *

Egypt: Petroleum

V. S. Swaminathan
London, England

EGYPT is probably more dependent on oil, both for industrial and domestic needs, than any other country of comparable wealth and population. Petroleum products account for close on 87 percent of the nation's sources of power. Kerosine consumption per capita is 10 times as great in Egypt as in France, and the figure for fuel oil is as large as in the highly industrialized economies of Britain and France. Between 1938 and 1952 the country's oil consumption rose five-fold; industrial production, two-thirds; the number of tractors in the fields and motor vehicles on the roads, doubled; and Cairo has now become a major world air junction. For these and other reasons the progress made by the Egyptian petroleum industry on all fronts is of more than ordinary interest.

It is a matter of history that crude oil was first found in Egypt in 1868, nine years following the drilling of the pioneer oil well in the United States; and the first well was drilled in 1886 on the shore of the Red Sea. It was the Gemsa oil seepage, a promontory adjoining the entrance to the Gulf of Suez. It stimulated prospecting which, in due course, led to the discovery of five oil fields on both shores of the Gulf. The underground geological strata in this region are highly disturbed, and here and there conditions were favorable for the trapping of oil. These closed traps were relatively small and the oil they contained was limited in quantity. For this reason exploration proved exceptionally difficult, and the discovery of oil in paying quantities had to await advanced engineering techniques and equipment. So it was that nearly four decades elapsed before production began at Gemsa.

Gemsa

After several trials the Egyptian Oil Trust discovered small, but useful, amounts of crude petroleum in 1909. Thus was born the country's oil industry some months after petroleum was found in commercial quantities in Persia. Production commenced at Gemsa in 1910, when the Egyptian Oil Trust was acquired by Red Sea Oilfields — a member of the Royal Dutch Shell Group, which was later to become the nucleus of the Anglo-Egyptian Oilfields (AEO) Ltd. It soon became evident that Gemsa would never become a major field. In the 17 years of its existence it yielded a total of only 193,000 tons; but it did suggest the presence of oil along the western littoral of the Suez Gulf.

On April 23, The United Arab Republic "desequestered" four oil companies acquired after the 1956 Suez invasion. This action marked the first major implementation of the Anglo-Egyptian financial accord signed in March to settle Suez-caused difficulties.

The first group of desequestered firms include Shell of Egypt, British Petroleum, Imperial Chemicals, and Anglo Egyptian Oilfields.

Hurghada

Thus, at Hurghada, 55 km to the south, the anticlinal structure of the limestone indicated promising prospects. Here AEO struck oil in 1913, and for quite an appreciable period this field supplied almost the whole of the country's liquid fuel needs. Late in 1952, after yielding 5,000,000 tons of oil it was approaching the end of its life. Of its 143 wells only 24 were producing with a daily output of 800 bbl of crude petroleum with 6400 bbl of water.

Ras Gharib

Although Gemsa was located as a result of seepages, and Hurghada selected for drilling because of a favorable structure visible at the surface, Ras Gharib did not suggest the presence of oil so easily. Although two

Problems and Prospects

European financial aid, American Engineering assistance attempt to bridge gap between crude availability and products demand through accelerated exploration program

wells were drilled there in 1921 and 1925 they found little oil. It was only following the development of modern geophysical techniques of mapping the invisible subsurface structure that AEO resumed drilling 12 years later. The first well gave an initial output of 168 tons a day, and in early 1953 Ras Gharib was yielding crude petroleum from five levels, so that very often two wells drilled side by side produced from different reservoirs. At the end of 1952 this field's 136 wells cumulatively yielded nearly 16,000,000 tons, and production, which reached its peak in 1947, was entering an era of gradual decline.

At Hurghada and Ras Gharib, as the wells approached depletion increasing quantities of salt water were produced with oil giving rise to emulsions. The heavy crude was mixed so intimately with the water that it was difficult to break down by heat and chemical methods alone. The first electric dehydration plant was therefore installed at Hurghada, which served as a model for dehydration processes elsewhere in the world. In due course, a newer and larger plant was built on the same principle at Ras Gharib costing $1,065,000.

Ras Sudr

When the second world war ended and conditions permitted, AEO resumed exploration not only on the west coast of the Gulf of Suez, but also in Sinai. Although other companies drilled at various places in Sinai as far as the Palestine border without success, the first post-war proved strike was that of AEO at Ras Sudr, not far from Suez, in 1946. Of 33 wells drilled here 18 produced oil.

Asl

In 1947, only 10 miles further south, the Asl field was discovered producing oil from 9 out of 28 wells drilled. Later in the same year some oil was found in an area between the two fields, known as Ras Matarma; but, issues raised by the Egyptian Mining Law of 1948 held up production for five years. Initial rate of output of Sinai fields was high, but later developments confirmed that the total amount of oil available was relatively small. Indeed, by the end of 1952 Sudr and Asl reached the acme of their production, and together, yielded far less than Ras Gharib was after 14 years of exploitation.

In conjunction with Socony-Vacuum Oil Company (SVOC) of Egypt Inc., with whom AEO jointly developed and operated the Sinai oil fields, two adjacent areas — Nebwi and Lagia — were also fully explored. The search was finally abandoned in 1950, following the drilling of 11 dry holes at an outlay of $1,400,000. The accompanying table gives the total number of wells drilled for oil in Egypt during the period 1886 to 1952:

	AEO and AEO/SVOC pool	Others	Total
Dry holes	124	93	217
Exhausted	93	15 (a)	108
Producing	195	1 (b)	196
Total	412	109	521

(a) Showing Abu Durba wells (doubtful)
(b) Well at Wadi Feiran

Structure Holes	
AEO	37
Others	23
Total	60

Thus in all 217 unsuccessful wells and 60 structural core holes were drilled in Egypt to the end of 1952, and substantial sums expended on oil search. One international company spent $16,000,000 in 10 years of exploration before abandoning its local operations without obtaining any reward for its investment. The fact is the geology of the potential oil-bearing areas in Egypt is broken up and complicated. And little or no information can be gleaned from the surface. Successful exploration entails a very sub-

Casing for Egypt's accelerated oil exploration program, is being unloaded at AEO (Anglo Egyptian Oilfields Ltd.) yard at Ras Gharib on the Gulf of Suez.

Two directionally-drilled wells, operated by AEO, extend out into the Gulf of Suez at Ras Gharib. Well foundations are built on the edge of a coral reef.

stantial amount of drilling at a cost of around $280,000 a hole. And oil, when found, exists in relatively small pockets.

Production Deficit

Thus, the gap between domestic oil production and consumption was widening. Egypt was importing nearly one million tons of refined petroleum products a year at an outlay, which in 1953 was placed at $36,400,000 in foreign exchange. Production declined sharply in Sinai at the beginning of December 1953, following the biggest producing well at Asl being affected by encroaching water. Worse still, exploration work was suspended for over five years since 1948. In early 1954, however, an agreement in principle was reached with the Egyptian Government in respect of a lease on the Ras Matarma property, and of prospecting licenses for which AEO had applied over various other areas. The implementation of this new pact enabled the company to resume its exploration program.

The Egyptian oil industry was marking time until the Suez crisis late in 1956. Early the following year a new department under the Ministry of Industry was set up by the government so as to increase state participation in the industry, and to supervise oil exploration in areas where licenses are held by the state.

Belayim, Feiram

In February 1957 International Egyptian Oil Company reached an agreement with the government, and ceded its local rights and obligations to Eastern Petroleum Company of Egypt. This concern developed a lucrative trend along the west shore of the Sinai Peninsula. In April 1958, 23 wells were producing 24,000 bbl per day at Belayim, where three rigs were operating. At Feiran field, 10 miles to the north, two wells had a total output of 400 bbl per day. A wildcat was being drilled at Sidri 10 miles north of Feiran.

Abu Rudeis

Another important discovery was made by the same company at Abu Rudeis, some 18 miles north of Feiran. Abu Rudeis 2 was completed in July 1957 for 1000 bbl per day of 23 deg oil on a ¼-in. choke from Lower Miocene, between 8592 and 8936 ft. Confirmation test was completed at Rudeis 3, close on 3000 ft south of the discovery well for 4400 bbl per day from the same pay zone. In April 1958, two wells were producing around 5000 bbl per day, with one rig drilling in the field. The general outlook was for stepped-up drilling in the Gulf of Suez area, including offshore drilling.

Ras Bakr

Also, General Petroleum Company, the state exploration undertaking, started wildcatting in early 1958. At Ras Bakr on the west side of Suez Gulf oil was discovered at a depth of 4250 ft.

On the other hand, the Sahara Oil Company ended prospecting operations last October (1958) after failing to find more than "occasional oil slicks" during a 4½ years' search costing $40,000,000. This company had a 90,000 sq mile concession, and also carried out an offshore seismograph survey from Alexandria to Sollum. Betty 1 in the center of the Qattara Depression was spudded in mid-September 1956, and abandoned the following June at 14,643 ft. Oasis 1 located in the extreme south, nearly 140 miles southwest of Cairo, was spudded in July 1957, and given up a month later at 6042 ft. Ghazalat 1 was spudded in September in Qattara, 35 miles north of the Betty well, and abandoned in January 1958 at 10,082 ft. Fughur 1, located near the Libyan border 75 miles inland from the coast was drilling early in 1958, and was given up last October.

Now Ras Gharib, along with Hurghada and Gemsa fields, lies on leases owned by AEO, a member of the Royal Dutch-Shell group. Since a substantial amount of British capital is involved in the Shell Companies Anglo-Egyptian's properties were "sequestrated" by the Egyptian government as a basis for reparation claims against the United Kingdom pursuant to the attack on Suez late in 1956. In the meantime, the Egyptian government continued to operate Ras Gharib, Hurghada and Gemsa fields, and jointly, with Mobil Oil Egypt Inc., Sudr, Asl and Ras Matarma fields.

It was announced November 17, 1958, that all branches of the oil industry in both Egypt and Syria, including prospecting and price fixing, were to be controlled by the new General Petroleum Authority with its headquarters in Cairo. A five-year program for Egypt is estimated to cost $124,000,000, partly split up thus: an oil processing plant ($14,000,000), expansion of government refinery at Suez ($12,600,000), extension to Alexandria refinery ($2,800,000) and oil exploration and prospecting ($16,800,000). Other equipment for this plan is to be obtained from West Germany under the $126,000,000 credit agreement concluded in March 1958.

Table 1. Egyptian Production, Drilling.

Field	1956 b/d	1957 b/d	Total wells drilled end of 1957
Ras Gharib	19,698	21,523	169
Hurghada	711	578	139
Gemsa	5	36	125
Belayim	4,913	12,666	27
Abu Rudeis	—	1,145	2
Feiran	579	360	5
Sudr	4,942	5,574	33
Asl	2,686	2,983	29
Ras Matarma	307	274	6
Total	33,263	45,140	535

In the last two years Egypt exported crude oil worth $7,000,000 not because of the inadequate capacity of her three refineries, but stemming from the heavy and sulfurous nature of a part of her output which provides 88 percent of fuel oil but insufficient quantities of lighter fractions like kerosine.

★ ★ ★

AEO-SOCONY jointly operated wells at Sudr. Flowing well in foreground; discovery well, on pump, is shown in background.

Israel:

Heletz field—

Is this the first chapter, or the complete story of oil in Israel?

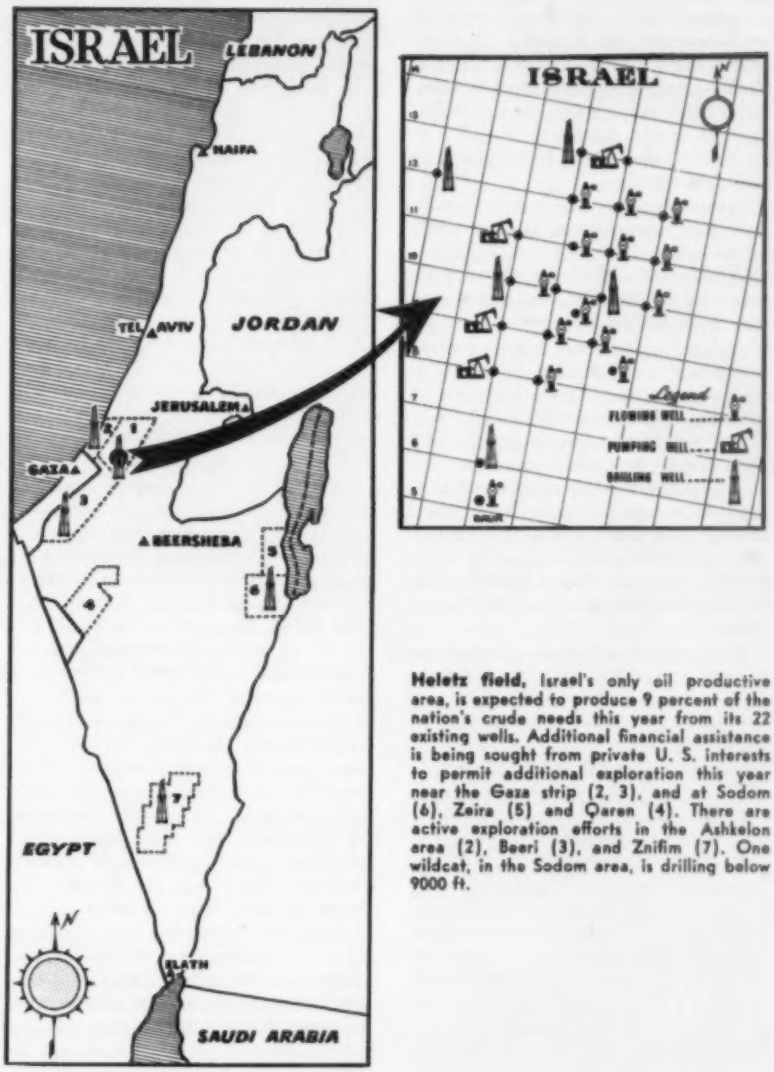
ISRAEL'S OIL LAW of 1952 is one of the world's most attractive to foreign capital, and due largely to its enactment this country, celebrating its tenth anniversary, became an oil producer three years later. Prospecting licenses were granted in 1953 to about a dozen companies, both local and foreign.

Up to now, however, only two companies (the Lapidoth Oil Company, and the Israel Oil Prospectors, Ltd., who operate jointly as the Massada Company) have struck oil at Heletz in south Israel. So far, 22 wells are in production in this field, and four others are being prepared for production. Average daily output of this field was 2542 bbl in March 1959, equivalent to around 9 percent of the country's oil requirements.

A total of $33,600,000 had been spent on oil exploration and production up to the end of 1957. So far, a total of 50 wells have been sunk, of which 30 are in the Heletz field; and the remaining 20, scattered throughout the territory proved dry. Layers of bitumen and asphalt were discovered in several locations, and oilmen deem that prospects are favorable for the discovery of oil in many parts of Israel, apart from the Heletz area.

Most of the 32 licensed companies are currently engaged only in geological and geophysical work and core drilling. Wildcatting is under way at Motza east of Jerusalem by the Judean Oil Company, and at Fosh Zohar adjoining the Dead Sea by the Naphtha Company, while a deep well is being sunk by Metsada, drilling arm of Lapidoth and Israel Oil Prospectors Ltd. in the Heletz field. Petroleum is produced at Heletz from a depth of around 5000 ft, but the deep test well has already gone down to 9000 ft, and a drill capable of reaching a depth of 15,000 ft is moving in.

Drilling started in May (1958) by Metsada at Saad, some 10 miles south of Heletz, and at Halutza in the central Negev by the Israel-American Oil Company.



Heletz field, Israel's only oil productive area, is expected to produce 9 percent of the nation's crude needs this year from its 22 existing wells. Additional financial assistance is being sought from private U. S. interests to permit additional exploration this year near the Gaza strip (2, 3), and at Sodom (6), Zeira (5) and Qaren (4). There are active exploration efforts in the Ashkelon area (2), Beeri (3), and Znifim (7). One wildcat, in the Sodom area, is drilling below 9000 ft.

According to the Petroleum Law 5712 - 1952, and the Petroleum Regulations 5712 - 1953 supplementing the basic law, the administration of new oil concessions is handled by the Petroleum Commissioner responsible to the Minister of Development. The law provides for a three-permit system: (1) a non-exclusive preliminary geological and geophysical survey; (2) intensive exploration license, and (3) a lease.

The license permits the holder to drill, and a discovery automatically entitles him to a lease with production

rights. A single license may not exceed 100,000 acres, and no one licensee may have more than three licenses, nor more than 250,000 acres in any one district.

Licenses are for three years, with extensions allowed by law up to a total term of seven years. If oil is found the licensee may have two years to define the field before he applies for a lease.

Exploration must commence within four months of the granting of a license and drilling within two years, and must be continuous thereafter. Leases must not exceed 62,500 acres each, nor may any lessee hold more than 187,000 acres under lease in one district.

Leases run for 30 years, and they are renewable for 20 years. If a discovery extends the tenure of a licensee, the lease will be in effect from the date the license would have expired in the absence of the discovery. Royalty to be paid to the Israel Government is 12½ percent.

Lessees may be required to satisfy domestic requirements before crude oil or refined products are exported. Unitization of leases is permitted. Also, necessary equipment for oil exploration may be imported duty-free.

A later amendment also frees oil companies, and drilling contractors operating in Israel, from payment of sales and excise taxes on locally produced materials, such as cement and tires, bought for petroleum exploration and development. Exemption from customs duties was broadened to embrace drilling contractors. These new exemptions are retroactive to April 1, 1954. Finally, provision for a depletion allowance became effective as of August 1956.

The problem of obtaining additional finance has of late acted as a serious brake on local oil prospecting. Plans are therefore under consideration for the formation of a National Oil Company, which would float debentures guaranteed by the government on the local market. In contrast to the other local oil companies formed and financed by existing institutions, the new concern would strive to raise its capital from the public, while its board would be composed of important local businessmen and bankers. The Israeli Government, in return for its guarantee, would receive a substantial share in the company if oil is struck.

In early 1957 oil imported through Haifa port, and refined by Consolidated Refineries there, had to be transported to other parts of the country largely by road and, to a lesser extent, by rail. Since nearly half the total quantity of petroleum products consumed are destined for the southern and central parts of Israel this was a costly proposition.

Therefore construction of a 6-in. pipeline connecting the Haifa refinery with storage facilities was commenced in early 1957. This 55-mile line with an annual throughput of 600,000 tons of products oil, and the storage installations in Tel Aviv was completed last June. This month also witnessed the completion of the last section of the Elath-Haifa crude oil line, linking the Red Sea with the Mediterranean.

The section from Elath to Beersheba at the northern part of the Negev (a distance of 140 miles) was completed in April 1957. This 8-in. line has a maximum throughput capacity of 1,200,000 tons a year. The second part of the line, from Beersheba to Ashdod Yam on the Mediterranean, 20 miles south of Tel Aviv, was commissioned in the summer of 1957. It eliminated the need for transporting crude oil from Beersheba to Haifa by the more costly road or rail routes. Instead, the oil is now pumped at Ashdod Yam into tankers lying offshore for sea transport to Haifa. This pipeline has now been extended along the Mediterranean littoral to Haifa, 90 miles to the north, so that petroleum can be pumped directly to the processing plant. The Ashdod Yam-Haifa section of the line is 16-in. in diameter, permitting an annual throughput of 5,500,000 tons. This capacity should prove useful if and when plans for a large-diameter (32-in.) line from Elath to the Mediterranean are realized.

In 1957 Israel's oil imports and consumption increased for the tenth year running to attain a new peak of 1,730,000 tons (450,000 tons in 1948). Last year, imports of crude oil amounted to 1,180,000 tons; fuel oil, 460,000 tons and petrol, kerosine and aviation gas, 92,000 tons. Imported crude oil is refined by the Consolidated Refineries in Haifa (owned jointly by Shell and B.P.), on behalf of three marketing organizations operating locally: (1) Pazz (newly-created company which has taken over Shell's marketing facilities in Israel); (2) Sonol (a subsidiary of Sonneborn Inc., New York, which purchased Socony-Vacuum's interests two years ago) and (3) Deleka (the Israel National Fuel Corporation).

A further substantial rise in imports and consumption may safely be predicted for the coming decade (1958-1967), though the rate of increase may be somewhat less than during the preceding 10-year period. An annual increase of 8 to 9 percent in each of the next five years would be a reasonable estimate in the light of the country's expanding agricultural and industrial production and the projected increase in power output. This means, failing new local oil discoveries, or increased output from existing fields, Israel's oil imports should go up. ★ ★ ★

Papua:

One 1000-bbl per day oil well "baits" companies to pour additional exploration capital into the island

ON November 3, 1958 the welcome news was announced that oil was flowing from Puri No. 1 well in Papua. This initial discovery in the Australian territory on the island of New Guinea was reported to flow at the rate of 1500 bbl per day.

The Puri well was drilled by the Australasian Petroleum Company, knowing too well that "a well doth not an oilfield make." The company is an exploration enterprise owned 45 percent by British Petroleum Exploration, 45 percent by Vacuum Oil Company Pty., Ltd., and 10 percent by Oil Search, Ltd. Exploration efforts in Papua, long prior and since the Puri discovery, have been enticed by "near" oil and gas finds.

Exploration for oil in this remote and inaccessible territory was notably encouraged by a gas blowout that occurred in Kurn No. 1 in early 1956. It was then that Australasian Petroleum experienced the first really encouraging event of its 20 years' search for oil in Papua, when this test blew out at 998 ft, with surface casing (18⅝-in. OD) cemented at 449 ft. Myron Kinley, well control specialist from Houston, Texas, was flown to the scene to take control. The well was entirely sealed off, with some gas continuing to escape around the plug. Fortunately, it did not catch fire. In mid-1956 a directional hole was completed and the high-pressure formation was safely mudded off. No attempt has since been made to exploit this gas, there being no local market for it. However, its presence was an indicator of the likelihood of finding oil in the vicinity.

Stanvac and BP interests continued their search in 1957 and 1958. In the former year Australasian Petroleum Company and the Island Exploration Company completed four dry holes to an average depth of 5824 ft.

During the first half of 1958 an additional dry hole was finished, and three more wildcats were being drilled. At Barikewa the well reached 13,046

Petroleum Find

Puri No. 1 rigsite, now Papua's only producing oil well. Transportation difficulties are such that, had the well not been successful, the rig would have been abandoned in the jungle.

ft on June 10; at Puri 1, 8021 ft and at Kurn 3, 3194 ft with 18⅝-in. casing cemented to 581 ft. The Puri well was drilled down to 10,000 ft, and last July testing of three zones began. The first showed gas containing hydrocarbons and a later test gave small quantities of liquid fractions. Then came the official intimation on November 3 of a flow of 70 bbl per day of condensate.

Papua has always been regarded as a most promising oil area by petroleum companies, as well as Australian authorities.

But until the Puri well strike, exploration had been carried on for two decades, and over $67,200,000 had been expended without locating oil. Indeed, in early 1958 both Vacuum Oil and BP made it plain that they were not prepared to put up any more money unless the year's drilling program brought "material encouragement." Oil Search, however, said earlier that it was prepared to "go it alone" in Papua if the bigger companies dropped out, and in the first week of November it filed a prospectus for a new concern to operate there.

Even if the discovery well fulfills its early promise, transportation of oil will pose a major problem since a pipeline will have to be built through exceptionally difficult terrain.

Just how formidable it can be is indicated from the company's decision to abandon the oil equipment at the wells, as this step would be cheaper than attempting to bring it out if operations were ended.

Whether the Puri oil flows on, or peters out in salt water, Australians will have no doubt on national grounds that the exploration must go on. Senator Spooner, the Australian Minister of National Development, affirmed: "Whichever way you consider the report of the flow of 1000 bbl per day in the Puri well, it is good news for Australia. At this stage, we do not need to consider whether or not there is a commercial pool in the Puri dome. The fact that a considerable flow has been struck in Papua after incessant search lasting 20 years, and after the expenditure of £A.30 million, is in itself a significant event. All Australians, while welcoming the discovery, will be waiting the results of continued testing and further exploration of Puri and other domes in this area."

In the afternoon of November 7, the Australasian Petroleum Company announced that the rate of oil production at Puri had slowed down since water had been entering the well.

One observer noted that water coming from the well could be a problem, but if the company cut the rate of oil flow the water level would probably disappear. He emphasized that the well was essentially exploratory, and that future wells could probably overcome difficulties stemming from water.

Exploration was somewhat advanced by a recent report that the Australian government would pay up to 50 percent of the cost of drilling deep holes in sedimentary basins which might contain oil either in Australia or in Papua.

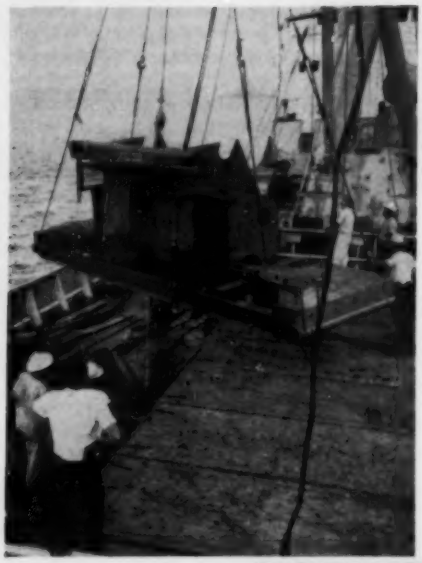
The Papuan Apinaipi Petroleum has announced that Mines Administration Pty. would begin a geological survey of the permit area held in the southeast end of the Puri dome.

The BP and Vacuum companies have since announced a decision to continue their exploration in Papua. This announcement was promptly followed by a withdrawal of the prospectus by Oil Search issued to raise funds it considered necessary if it were forced to "go it alone." ★ ★ ★

Helicopter base serving Australasian's rig at Puri. Note the elevated houses and walkways. Helicopters are used exclusively in servicing the rigs, as well as transporting them.

Guatemala: THE BIG RIG FLY

...BY WING, FROM SHIP



At 11:00 p.m. on March 14, 1959, The Ohio Oil Company spudded in its first exploratory well, Chinaja No. 1.

With the spud-in, the company climaxed the largest airlift the oil industry has seen in its 100-year history.

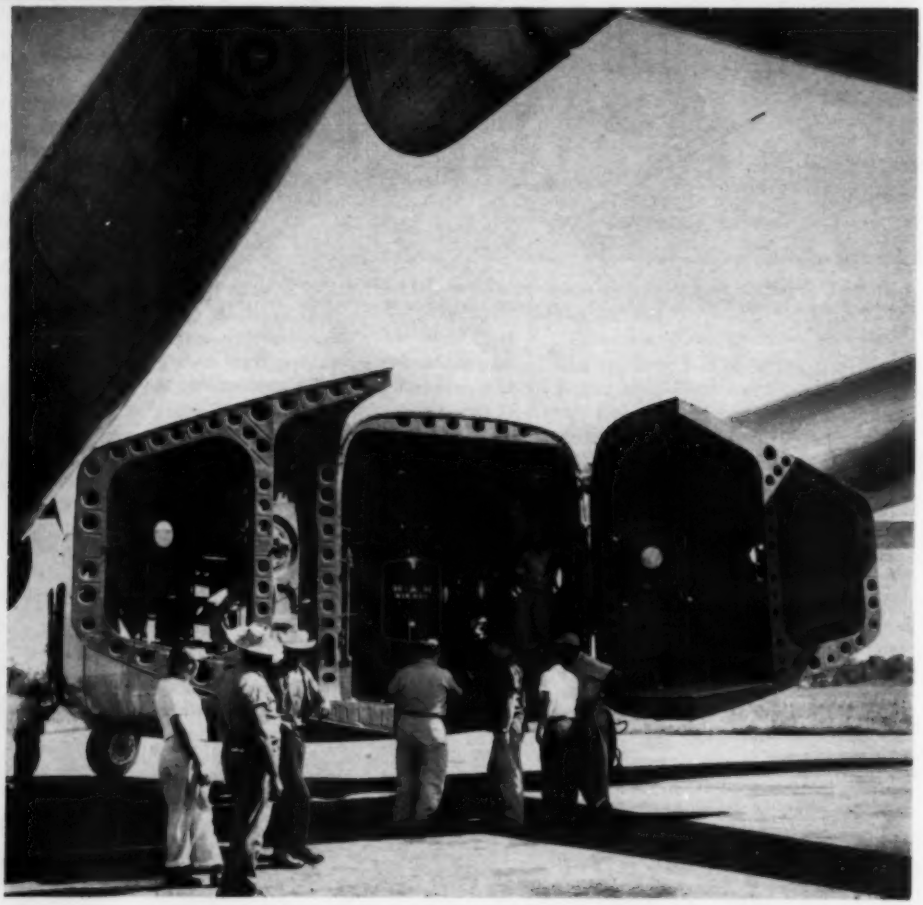
The company's exploratory well has started drilling at the Chinaja wellsite in the Department of Alta Varapaz, 110 miles in the interior. Starting of the well is a milestone in work begun 10 years ago.

According to J. P. D'Artois, resident manager in Guatemala City, "The rotary rig is capable of drilling to 13,000 ft. However, drilling may stop short of that depth, if oil production is encountered or if basement rock is reached at shallower depths."

The company airlifted approximately 4,000,000 lb to get the rotary rig and all the necessary equipment and supplies into the interior. A 6,000,000 lb total will have been ferried by aircraft from Puerto Barrios on the Caribbean to the wellsite if it is necessary to drill the wildcat well to 13,000 ft.

The huge airlift used three C-82 "Flying Boxcars," two owned by the company and one leased, making several trips daily carrying up to 16,000 lb of cargo

Drawworks housing is brought up from the hold of the freighter Christiane at Matias de Galvez. Several ships carried supplies and equipment.



Huge jaws of Flying Boxcar open to swallow needed supplies and drilling equipment. Three were used in initial airlift. Here a diesel truck begins piggy-back ride into the interior.

-IN

TO SPUD

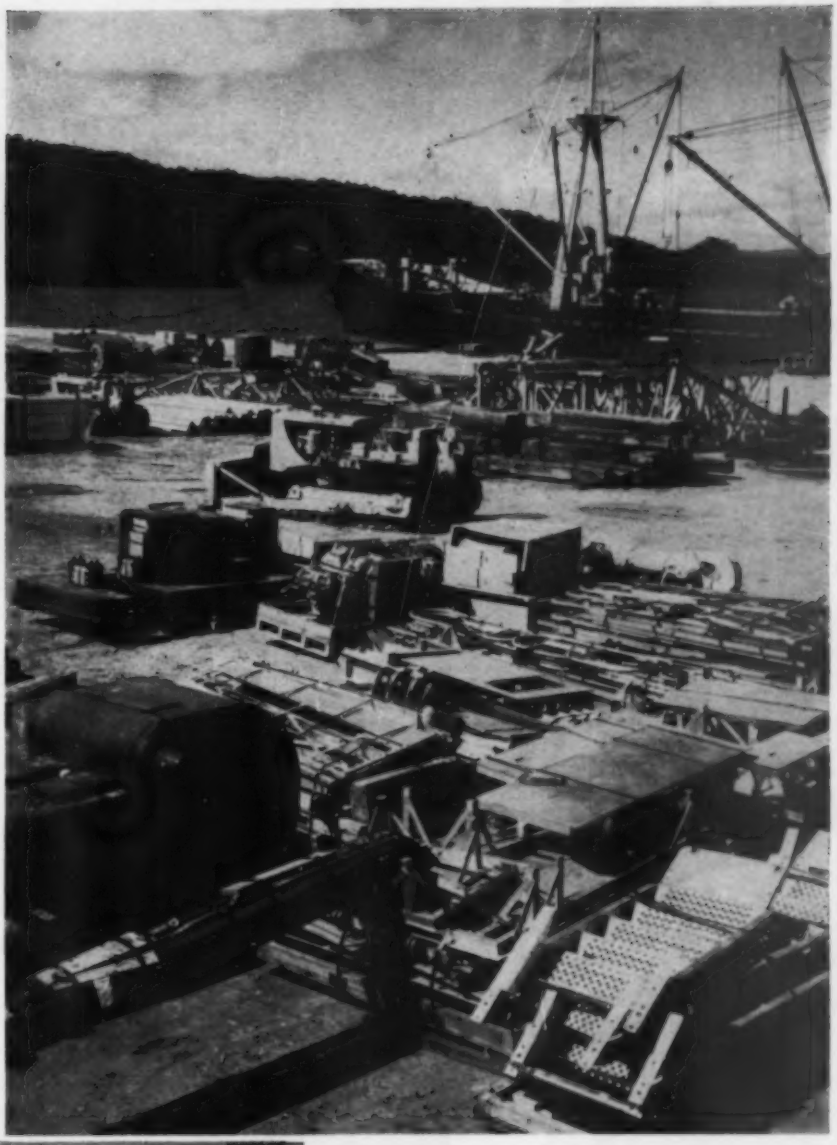
per flight. Begun in January, the airlift was under direction of M. C. Murphy, manager of aviation. To make the airlift possible, it was necessary to hack a 4000 ft air strip out of the jungle. The strip is six miles by road from the wellsite, located on the Arruga Grande (Big Wrinkle) anticline.

Currently one C-82 and one C-47 are being used to bring in supplies for the well and crew.

This road, also built by the company, with its sharply winding switchbacks, climbs 1000 ft up the side of the structure.

To airlift the rig called for many equipment modifications. The drawworks of the rig are normally broken down to adhere to highway limitations. However, the largest portion weighs 46,000 lb, nearly three times the capacity of a C-82. So the rig had to be dismantled further to fit into the plane and held to not more than 34 ft long, 7½ ft wide and 8 ft high. Supervising this project was H. D. Hoopman, Ohio Oil of Guatemala operations manager.

D'Artios said that "While the cost of airlifting the heavy drill-



Stockpile at Puerto Matias de Galvez, Guatemala, took on the look of a World War II supply depot, as freighter Christiane unloads cargo. From here equipment and supplies were trucked to the airport at Puerto Barrios where the 110-mile inland airlift began.

Checking the lists of supplies arriving are pilot Charles Hirst, H. D. Hoopman, operations manager, C. K. Morgan, controller, and Mario Loranzano, loading supervisor, all of Ohio Oil of Guatemala.

Discussing take-off plans at Guatemala City's La Aurora airport are Hoopman, J. P. D'Artois, resident manager of the company, and pilot Hirst. One C-82 Flying Boxcar and this C-47 will be used in ferrying supplies.

ing equipment is high, the cost is still considerably less than the construction of roads to the Arruga Grande. Cost of opening up passable roads across rugged mountain terrain and through rain forest and jungle is prohibitive. The airlift was the only economically feasible method of getting equipment in for exploratory drilling."

Despite unseasonal rains the airlift and trucking operation went much faster than anticipated. The average rainfall in the lowlands of Guatemala is 200 in. The major difficulty encountered was trucking the equipment to the wellsite, an operation slowed considerably by rain.

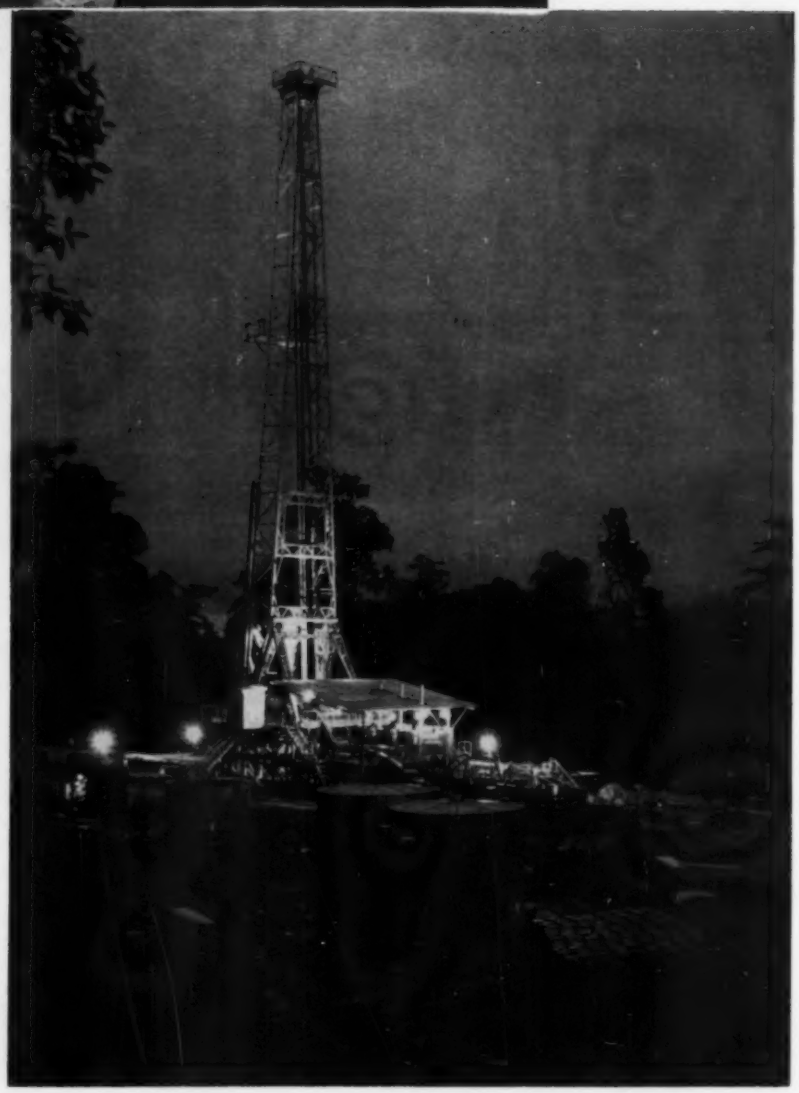
International Brown Drilling Corporation of California is drilling contractor on the well.

Ohio Oil of Guatemala is operator for the test on a 109,539-acre unitized block held by Ohio Oil of Guatemala, Amerada Petroleum Corporation of Guatemala, Continental Oil Company of Guatemala and Union Oil Company of California. Each company holds 25 percent interest in the acreage.

Acknowledgment

Grateful acknowledgment for permission to reprint this article is due Eugene L. Price, editor of *The Beacon*, employee publication of The Ohio Oil Company, where the article originally appeared.

★ ★ ★



Spud-in of Chinaja Well No. 1 at 11 p.m. on March 14, climaxed 10 years of preparation.

Testing Lab for Logging Cable

IN THE HOUSTON PLANT of Schlumberger Well Surveying Corporation, engineers operate a unique laboratory for study of the electrical and mechanical characteristics of its logging and perforating cables. Developed over a period of several years, the laboratory has been expanded and improved with completion of new engineering facilities at the company's headquarters.

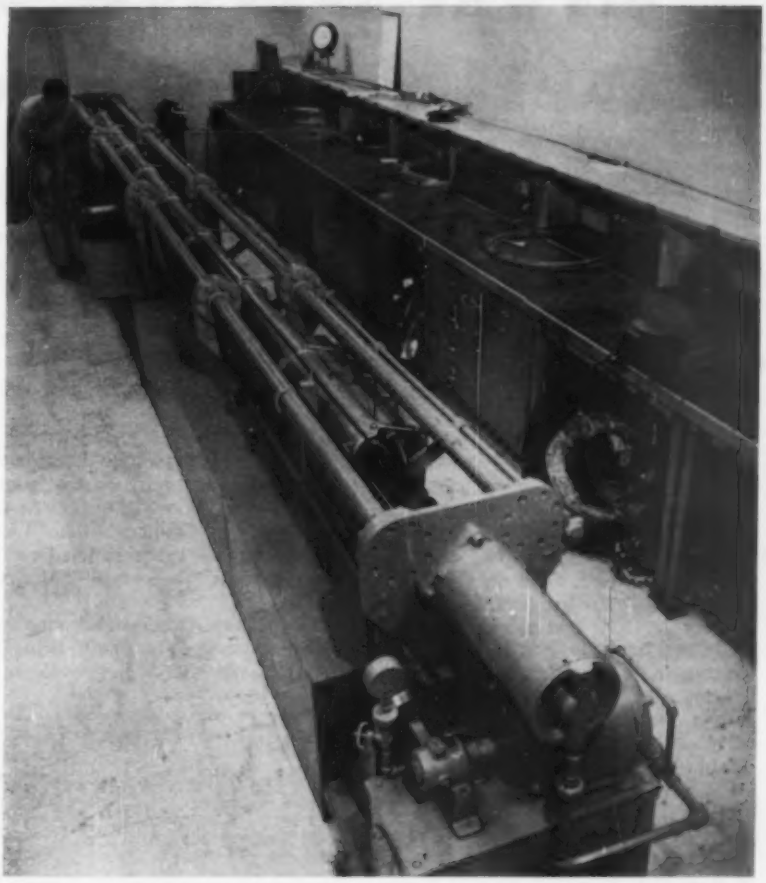
The cable testing laboratory was constructed to carry out two functions: (1) To study the stretch characteristics, strength and deterioration of present cables under simulated well conditions, and (2) to design better cables. Results of the laboratory testing have increased the accuracy of depth measurements, improved the electrical and mechanical reliability of cables, and reduced costs of operation by prolonging cable life.

All Schlumberger operations are performed with instruments lowered in wells at the end of steel armored cable. The company considers accuracy of depth measurements to be of equal importance with the accuracy of the electrical measurements recorded by the instruments themselves. Present logging cables of the company consist of 6 insulated wire conductors equally spaced around a central core. These conductors are covered by 2 layers of steel wire armor. The 2 armor layers are spiraled around the conductors in opposite directions to minimize twist or rotation. Perforating cables have the same type of armor but contain a single conductor.

Principal feature of the cable testing laboratory is its "Extension Bench." This equipment, designed and built by company engineers, is used on both present cable types and on new designs to establish their strength and stretch characteristics. The extension bench can test a 25-ft length of cable, applying a maximum tension of 20,000 lb, and measuring elongation with an accuracy of one thousandth of one percent. The equipment was built large enough to accomodate a 25-ft length of cable in order to eliminate end effects encountered in testing shorter lengths.

The test length of cable is enclosed in an electrically heated chamber capable of raising the cable temperature above 400 F. Uniformity of temperature along the cable is maintained by a system of 8 thermocouples and 16 thermostats.

Elongation of cables versus tension and temperature is carefully measured and automatically plotted on charts for all cable types now in use. One application of these charts is the determination of the stretch correction to be made to depth measurements. Each field unit is equipped with an accurate tension measuring device. By noting the tension at any depth the field engineer can use the chart to correct depth measurements for cable stretch.



"EXTENSION BENCH" in Schlumberger's Houston laboratory enables study of strength, stretch characteristics, and deterioration rate of its logging and perforating cables. A heating jacket encloses the test cable.

To assure continuing accuracy of the stretch charts, field locations are submitting to the laboratory numerous samples of used cable with detailed case histories. These are compared with performance of new cables to determine possible effects of cable age (or number of operations made by the cable.)

A unique feature of the extension bench is the freedom of the cable to rotate under any tension. This is a necessary duplication of conditions in surveying wells, where the cable and its suspended instrument are normally free to rotate continuously. The extension bench makes use of what may be termed a floating piston. Tension on the cable is obtained by fixing one end and attaching the other to a piston within a hydraulic cylinder. In ordinary construction of such machines the piston is equipped with piston rings. In the device the piston rings are eliminated.

When oil is pumped into the cylinder to exert a tension on the cable a part of it flows past the piston along the cylinder walls. Thus the piston floats on a film of oil and is free to rotate. At 20,000 lb tension, the oil escapes past the piston so that, even at this tension, the cable can be rotated by a small pressure of the fingers. The extent of the "free" rotation of the cable as tension is increased is one of the cable characteristics measured. ★ ★ ★

Cuba:

Civil Strife Calms; Drilling Resumes

Back to normal operations predicted by end of year — if government does not revise oil laws

THE CIVIL STRIFE which tore Cuba in 1958 — especially during the last half of the year — put the damper on oil exploration very effectively. Since much of the country could not be visited, and normal transport and traffic was shut off, most companies shelved their plans until the political situation improved. With the flight of the Fulgencio Batista government on January 1, 1959, and the installation of Fidel Castro in power, sweeping changes in the economic life of the country were instituted. It is still too early to say how these changes will affect the oil industry, but it appears that the government does not plan any great revision in the oil laws.

The Cay Sal well, drilled to 18,906 ft some 40 or 50 miles north of central Cuba, attracted widespread attention. The test has just been bottomed by Baham as California Oil Company and Bahamas Exploration Company, wholly-owned subsidiaries of Standard Oil Company of California and Gulf Oil Company respectively. Since the well was drilled as a tight hole, it is not known what possibilities of finding oil are thought to be.

The biggest blow to Cuba came through Cuban Stanolind Oil Company's decision to leave, but their decision was not based primarily on what they conceived oil possibilities to be in Cuba, according to their contract partners. Trans-Cuba Oil Company, one of the two firms which had given Stanolind the farmout, has resumed drilling on the properties Stanolind left, and is now putting down its second 4000 to 5000 ft test.

In general, activity is picking up where it left off when the revolution came along, and it appears probable that by the end of 1959, the oil business in Cuba will be working hard and back to normal.

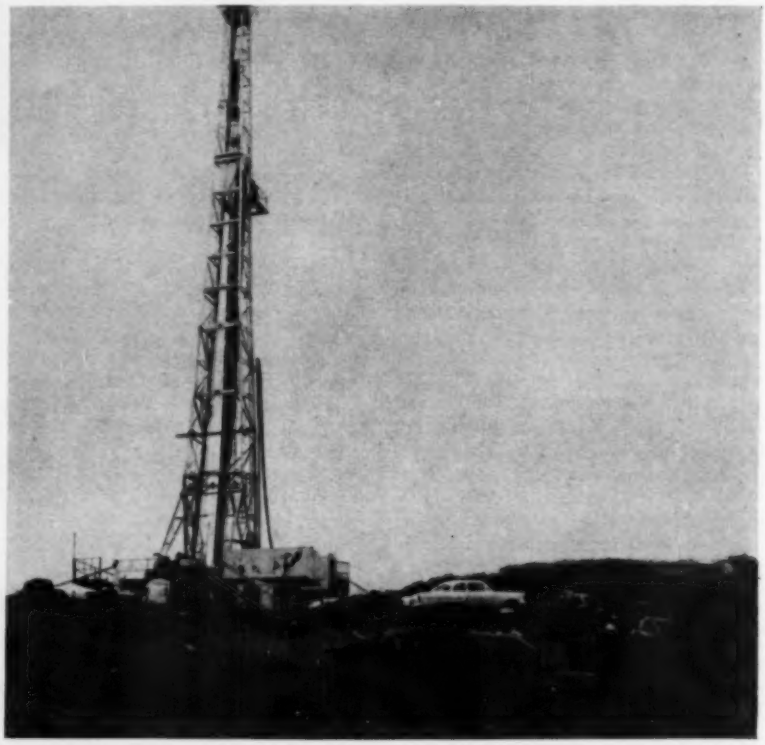
Plans of the new government call for a complete and accurate geological map of the island, and an aerial survey of the entire island is also to be finished soon. Most of the work on the latter had been done when fighting made it impossible to continue. These two projects, rapidly being handled, will contribute much to the oil industry here.

The Atlantic Refining Company of Cuba is expected to resume its drilling program, since the Cuban revolution has subsided.

Texaco, which drilled one 10,000 ft test, then announced it would drill no more, has now reversed itself and is planning to drill another 10,000 ft hole in central Cuba.

Cuban Kewanee Oil Company is also carrying on a joint venture with Atlantic in the north central Cuba area.

Consolidated Cuban Petroleum Corporation has scheduled a 6000 ft deep test of the Motembo naphtha field. This test is now waiting on orders at 1730



Escambray No. 1, being drilled by C. J. Simpson Drilling Company for Consolidated Cuban Petroleum Corporation on farmout from Cuban Gulf Oil in Las Villas (Central) Province.

ft; it will be the first well in Motembo drilled below the 3000 ft mark.

Cuban Stanolind Oil Company, a subsidiary of Standard of Indiana, paid a penalty estimated at about one million in late 1958, leaving Cuba, and turned over the rights it held to Trans-Cuba and CVOVT.

Trans-Cuba Oil Company and Cuban American Drilling and Exploration Company have also announced programs for 1959.

Present Activity

The present activity indicates that Cuba is recovering from the slump which began in late 1957 and continued through 1958. Actual expenditures of oil companies in Cuba were estimated by Cuba Petroleum News Digest as $250,000 in 1952; $500,000 in 1953; $750,000 in 1954; $3,000,000 in 1955; $12,000,000 in 1956; $10,000,00 in 1957; $4,000,000 in the first six months of 1958. Expenditures for the last six months of 1958 should amount to about $6,000,000, and it appears that about $12,000,000 will be spent in 1959.

Drilling commitments and obligations for exploration are estimated as $500,000 in 1952; $750,000 in 1953; $3,000,000 in 1954; $15,000,000 in 1955; $40,000,000 in 1956; $42,000,000 in 1957; $44,000,000 in 1958. These commitments may rise or fall in accord with changes of interest in Cuba, as well as showing fluctuations due to possible new discoveries.

Last Discovery

The last discovery was Guanabo field, on the north coast of Havana province near the city of Havana, in 1957. There are six other producing fields in Cuba: Bacuranao-Cruz Verde and Santa Maria del Mar oil fields in Havana province; Jarahueca oil field and Motembo naphtha field in Las Villas province; Jatibonico and Catalina oil fields in Camaguey province.

Cuba California Oil Company (Standard of California) has considerable drilling commitments, and has done extensive geophysical and geological work but no drilling to date. Reiter-Foster Oil Corporation made a farmout of its Cuban properties to Union Oil Company of California. Union Oil has enlarged its office force in Havana, and is carrying out geological studies but has not begun drilling. United Cuban Oil Inc. has reported discussions are still under way regarding a possible farmout of some of its properties near Havana.

Studies Complete

The Pan American Land and Oil Royalty Company has completed preliminary studies on its Cuban holdings through a management agreement with DeGolyer and MacNaughton.

Cruz Verde No. 1, discovery well now on pump in Salomon Concession near Havana.

Most companies have completed their geophysical work, and the absence of seismic, magnetometer and gravity-meter crews now does not indicate a lack of interest in exploration, but rather that preliminary work has been done. The interpretation and correlation of the results obtained has proved very difficult in most instances, and many companies are somewhat puzzled over the question of interpretation. It seems likely that little new geophysical work will be done until results of the past work can be better understood.

Geophysical Work

Geophysical work amounted to 28 crew months in 1954; 35 in 1955; 80½ in 1956; 41 in 1957 and 3 in 1958. Practically all geophysical work done in 1957-1958 was seismic, with about 16 crew months work on water and 25 on land. The evaluation of the data obtained is now occupying the geophysicists in Cuban oil companies.

Footage drilled in Cuba, excluding core holes, was 80,000 ft in 1954; 248,831 in 1955; 278,515 in 1956; 195,859 in 1957 and 145,036 in 1958.

The speed with which drilling programs of majors and independents are now put into operation will determine how much footage is drilled in 1959.

There are 18 rotary rigs in Cuba now, but most of these are now inactive, or engaged in workover. The majors are in the preliminary stages of their exploration programs, and they have taken the dominant role previously held by independent wildcatters. There has also been a tapering-off in the unrestrained wildcatting enthusiasm among small private and independent companies.

In 1957 there was a large amount of development drilling in Bacuranao-Cruz Verde, and to a lesser extent in Motembo and Guanabo fields. In 1957 the emphasis was on development drilling, since 125,000 of the total 195,000 ft drilled was in field areas.

In 1956 emphasis was on wildcatting and in 1958 the trend was towards more wildcat drilling. Cuban Kewanee Oil Company drilled a deep test in north central Cuba, Collazo No. 1 to 13,030 ft in 1958. This is the deepest test ever drilled in Cuba. Shell Oil Company participated in drilling the Manuy No. 1 well off north central Cuba to 8897 ft. Operator was La Estrella, in which Shell, Esso (NJ) and Atlantic all have an interest. Cuban Stanolind Oil Company drilled to Tortuga Shoals No. 1 off the south central coast of Cuba to 9703 ft. Many companies are now thinking in terms of more deep tests, and less shallow drilling.

Production Declines

Production showed a further decline in 1958, and unless new wells are brought in or new fields discovered, production will probably continue to decline mildly in 1959. Cuba produced 57,173 bbl of oil in 1954; 381,824 in 1955; 543,121 in 1956; 394,787 in 1957; 343,532 bbl in 1958.

Production in Jatibonico field, the largest producer in Cuba, was 945 bbl of oil per day in Jan 1957; 671 bbl of

oil per day in April 1957; 824 bbl of oil per day in July 1957; 807 bbl of oil per day in October 1957; 851 bbl of oil per day in January 1958; 585 bbl of oil per day in April 1958; 630 bbl of oil per day in June 1958.

Catalina produced 12 bbl of oil per day in January 1957; 34 bb of oil per day in July 1957; 12 bbl of oil per day in January 1958; 12 bbl of oil per day in June 1958.

Jarahueca produced about 20 bbl of oil per day during 1957 and about 100 bbl of oil per day during the first six months of 1958.

Motembo produced about 12 bbl of oil per day in 1957 and about 10 bbl of oil per day in the first six months of 1958.

Santa Maria del Mar produced 90 bbl of oil per day in January 1957; 68 bbl of oil per day in July 1957; 16 bbl of oil per day in January 1958; 29 bbl of oil per day in June 1958.

Guanabo gave 20 bbl of oil per day in January 1957; 66 bbl of oil per day in July 1957; 129 bbl of oil per day in January 1958; 97 bbl of oil per day in June 1958.

Cruz Verde field produced 91 bbl of oil per day in January 1957;121 bbl of oil in July 1957; 218 bbl of oil per day in January 1958; 118 bbl of oil per day in June 1958.

1864 Discovery

Bacuranao oil field was discovered in 1864. It is a shallow serpentine field, with production of parafin base crude of about 28.0 deg gravity coming from 500 to 2000 ft. Motembo was discovered in 1880; it produces natural distillate (naphtha) from 400 to 1700 ft. Naphtha is 60.0 to 62.0 gravity and Motembo is a shallow serpentine field. Jarahueca shallow serpentine oil field was discovered in 1943. Production is from 500 to 3000 ft and is parafin base crude of 38.0 to 40.0 gravity.

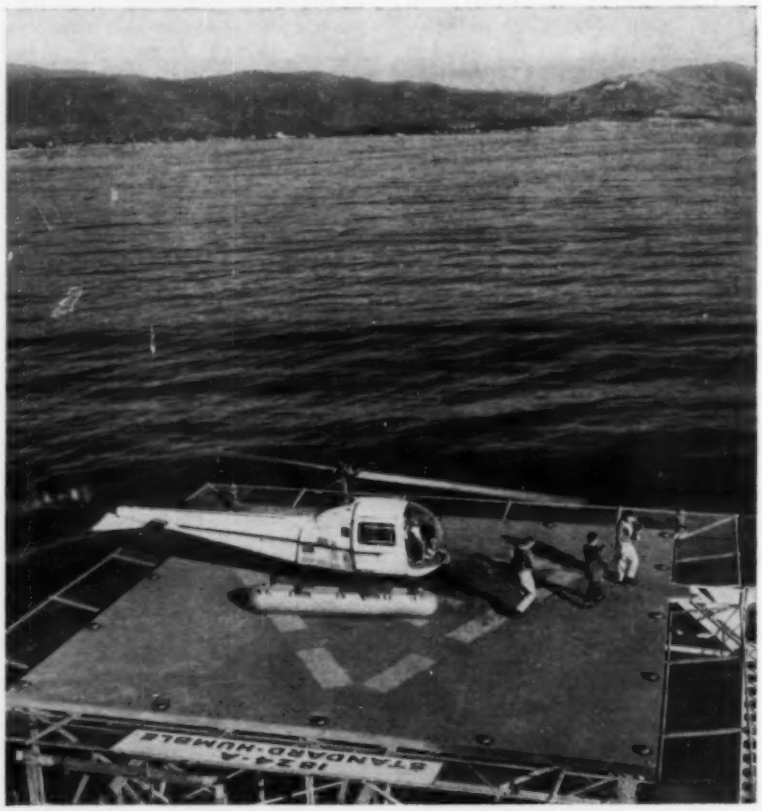
Jatibonico field, discovery of which set off the present boom, was found in 1954. Production is 15.0 to 16.0 gravity asphalt base crude from sedimentary formations from 1100 to 1300 ft. Cruz Verde, considered by some geologists as an extension of Bacuranao field, was discovered in 1955. It produces parafin base 28.0 deg crude from shallow serpentine in the 1000 to 1300 ft range. Santa Maria del Mar was found in 1955. It is a shallow and deep serpentine producer, giving both parafin and asphalt base crudes ranging from 16.0 to 28.0 deg from 2200 to 6000 ft. Catalina was discovered in 1956 and produces 32.0 gravity parafin base crude from sedimentary formations at 7000 ft. Guanabo was found in 1956 and gives 8.0 to 11.0 deg asphalt base crude from sedimentary formations at 1400 to 2200 ft. ★ ★ ★

Helicopter Shuttle Service

. . . provides Standard-Humble with constant link between first major West Coast offshore platform operation and the California mainland

HELICOPTERS are helping oilmen make history in 100 ft water off the California Coast.

In September 1958, Standard Oil of California (Western Operations, Inc.) and Humble Oil and Refining Company brought in the first full-fledged wildcat well drilled on a California offshore lease in some 30 years. To date the joint venture has paid off with two producing wells, with 22 more possibilities remaining from the same platform. Operations on the third well on the 5500-acre offshore state lease have been suspended at a depth of 8646 ft. Although dry, the hole will be direc-



Estimated 10,000 passengers have commuted to Standard-Humble offshore oil rig in first five months of helicopter taxi service. Average of 25 daily trips are made, transporting 60 to 70 men plus tools, supplies and necessities to keep rig going 24 hours a day, 7 days a week.

Towering 217 ft above Pacific, Standard-Humble offshore platform withstands tides which have reached 40 ft at times. 40-by-40 ft heliport serves as a roost for busy helicopters.

First full-fledged wildcat drilled on a California offshore lease in some 30 years, Standard-Humble joint venture has brought in two wells in three tries with a chance of a total of 25 slant wells from platform.

tionally redrilled to test another part of the lease.

The rig, located eight miles below Santa Barbara and two miles seaward from Summerland, is manned by crews flown aboard day and night by little "choppers" operating out of nearby Carpinteria.

Although the service has multiple benefits, its basic advantage is saving time. The helicopters airlift crewmen to and from the rig in 6 minutes, a trip that requires an average of 40 minutes by boat from Santa Barbara.

The shuttle service to the platform is particularly heavy during shift changes at 7 a.m., 3 p.m. and 11 p.m., but the choppers are busy through most of the daylight hours as well, averaging some 25 round-trips per day in transporting drilling crews, technicians of all kinds, supervisory personnel and engineers.

They also carry light cargo, tools and small emergency parts.

A thorough analysis by K. V. King, manager of aircraft services for Standard Western, and Dave Goodwill, producing department superintendent for Standard's Santa Barbara district, showed it would be feasible to provide regular airlift for crewmen. They evaluated the plans offered by several helicopter companies and inaugurated the personnel shuttle service last September.

Two helicopters were assigned to the job — a four-place Bell 47J and a three-place 47G-2. Working out of Parsons Air Park, Carpinteria, California, the airlift operation has virtually worn a groove through the air between the field and the rig since that time.

Crewmen park their cars at the field, step on the scales in a small office to record their weight, don Mae West life preservers for the short flight, then climb into the helicopters, three men per hop.

In 6 minutes the little choppers settle down to the offshore platform on their flotation gear and the passengers jump out to give their Mae West to crewmen going off shift. They, in turn, climb aboard and 6 minutes later they are back at the airport.

The operation moves like clockwork, with the crews taking precedence over all others who wish to fly to or from the rig.

24-Hour Service

The shuttle functions at night the same as it does by day to man the drilling operations around the clock — and only once to date has a heavy surface fog caused a flight cancellation. On that occasion boats couldn't move either.

Although time saving is the paramount reason for the helicopter service, there are other benefits: (1) Crewmen traveling by helicopter don't become seasick; (2) the choppers land men gently on the platform pad, even in a brisk wind; (3) official requiring a hurried trip to the rig does not have more than 6 minutes waiting time — even with only one helicopter working, a round trip can be made in 12 minutes. In addition, the helicopters are always available for fast transportation to shore in case of injury or other emergency.

Standard Western and Humble have drilled two productive wells out of three in only a few months of offshore wildcat operation from the platform, and the rig is designed to permit the drilling of 25 slant wells in the lease area. Production, however, must await the completion of submarine lines that will carry the oil to tank farms ashore.

But offshore drilling has proved out on the West Coast and other areas approved by the state will be explored . . . and to be sure, there will be more helicopters servicing the rigs. ★ ★ ★

THE ATLANTIC LECTURES OF THE UNIVERSITY OF TEXAS

PART 8

Injection Pattern Sweepout Efficiency

Recovery from an injection project directly reflects pattern sweepout efficiency. Study of this sweepout has led to improved predictions of field results and has pointed to areas of needed research

Ben H. Caudle, *Senior Research Chemist, Atlantic Refining Company, Dallas, Texas*

A RESERVOIR ENGINEER must answer many questions in performing his job. Probably the most important question is: "How can we get the most oil for the least expense in a given reservoir?" This is a most difficult question, for the reservoir engineer must choose between natural depletion and one of the many secondary recovery schemes. He must predict the amount of oil to be recovered for all of the alternatives before he can choose the method best suited for any specific reservoir.

In secondary recovery a fluid — such as gas or water — is forced into the producing formation to flush the oil from the rock toward the producing wells. To predict the recovery we must know how much of the oil is flushed from the reservoir rock by the injected fluid. This is usually called the "displacement efficiency." Normally it is measured by displacing oil from samples of the reservoir rock by the fluid in question.

This, however, is only half of the information necessary to calculate the expected recovery. In addition to knowing what the displacement efficiency will be, we must be able to predict the fraction of the reservoir which will be invaded by the injected fluid. Only by combining these two factors can we calculate the oil production to be expected in a secondary recovery project. It is obvious that a non-homogeneous reservoir — such as one having strata of different permeability — will not be invaded evenly or completely by the injected fluid. It is not so obvious that large areas of a homogeneous reservoir can remain untouched by injected fluids.

Five-Spot Sweepout Pattern

To illustrate this lack of complete areal invasion, Fig. 1 shows three stages in the advance of a fluid in a five-spot system. This simplified example is for a case in which the oil flowing toward the well and the injected fluid have the same viscosities and effective permeabilities. When the fluid first leaves the injection well, it flows equally in all directions. Thus, early in the injection history, the leading edge of the injected fluid advances in a circular pattern as shown by the dotted line in Fig. 1. Later, this leading edge becomes influenced by the pressure sink at the producing wells and the part of the leading edge nearest each producing well begins to cusp as shown by the dashed line in Fig. 1. At the same time, the advance of the injected fluid toward adjacent injecting wells is slowed because of the interference of the flow lines with those of adjoining patterns.

These influences eventually cause the injected fluid to reach the producing well as a pointed projection while some areas of the reservoir remain full of oil. The shape of the front at the time of break-through is shown by the heavy line in Fig. 1. The shaded areas show the part of the system not invaded by injected fluid at this time. Although a

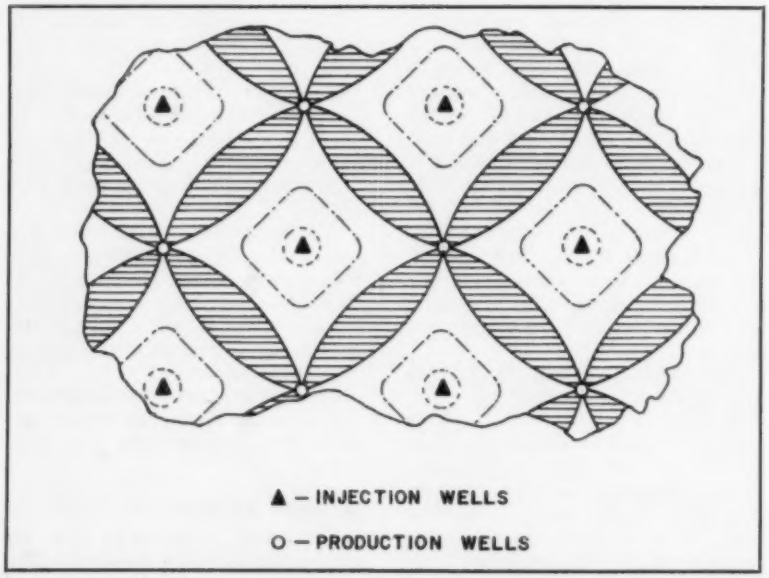
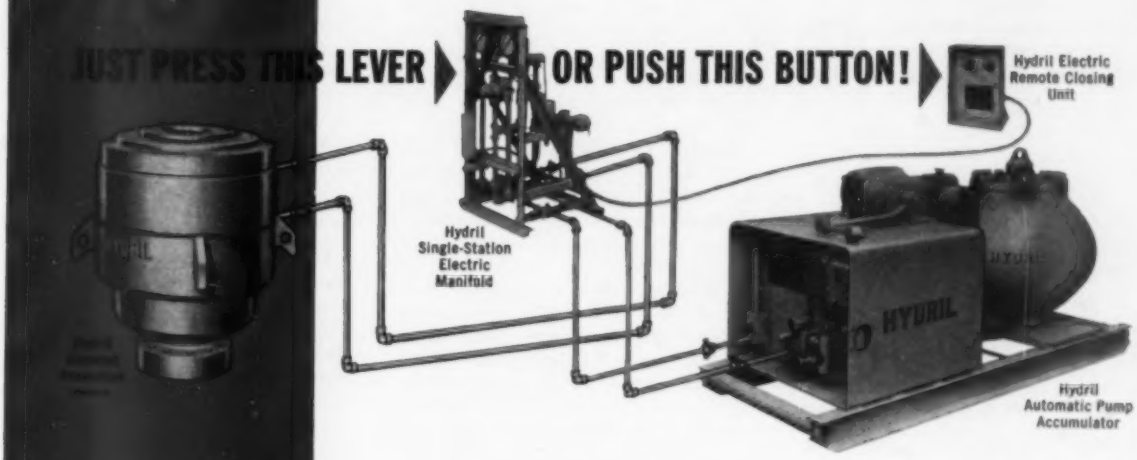


FIG. 1. **Flood advance** in a five-spot system illustrates three stages of the injected fluid front.

to TAME a kicking well...


JUST PRESS THIS LEVER
OR PUSH THIS BUTTON!
Hydril Electric Remote Closing Unit
Hydril Single-Station Electric Manifold
Hydril Automatic Pump Accumulator

THE HYDRIL

ENGINEERED SAFETY SYSTEM

YOU'RE LOOKING AT the most complete... and most flexible... combination of equipment ever offered to control the menace of downhole pressures. The Hydril Safety System enables all drilling operations to proceed with confidence that dangerous well pressures are under positive control.

Flexibility of the system enables the operator to choose from a wide range of sizes, types and capacities of Hydril Blowout Preventers, Automatic Pump Accumulators, and Control Manifolds. Accumulators are available for electric or gasoline-engine operation. Hydraulic power source and control devices can be located at a safe distance from the well, with additional controls, of course, within the driller's reach.

Let your Hydril representative show you how the Hydril Safety System is tailored to fit *your* well conditions ... and how

HYDRIL TAKES THE BLOW OUT OF BLOWOUTS!

SALES OFFICES
CALIFORNIA
Bakersfield
Los Angeles
Ventura
LOUISIANA
Harvey
New Iberia
OKLAHOMA
Oklahoma City
Tulsa
PENNSYLVANIA
Rochester
TEXAS
Corpus Christi
Dallas
Houston
Midland
Odessa
WYOMING
Casper
NEW MEXICO
Farmington
NEW YORK
New York
CANADA
Calgary
Edmonton

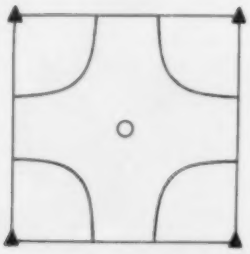
HYDRIL COMPANY
714 WEST OLYMPIC BOULEVARD
LOS ANGELES 15, CALIFORNIA
FACTORIES AT
LOS ANGELES, HOUSTON, TEXAS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

part of this remaining area can be contacted by continuing the injection, the oil production rate will drop, and the system will gradually become uneconomic to operate.

Experimental Studies

For many years our only knowledge of pattern sweepout efficiencies came from analyzing simple systems like the one just discussed. It was assumed that the lines of constant pressure (isopotential lines — which fix the lines of



▲ – INJECTION WELL – PRESSURE SOURCE

○ – PRODUCTION WELL – PRESSURE SINK

FIG. 2. **Element of a five-spot** injection system illustrates "cusping" of fluid front toward a production well and interference of fronts from neighboring injection wells.

flow and the pressure gradients) did not change as the leading edge of the injected fluid traveled through the reservoir. One example of this special case is where the fluid viscosities and the effective permeabilities are the same. With this assumption, it was possible to calculate the pattern sweepout efficiency for systems of simple geometry. It was also possible to model this system by using the analogy between fluid flow in a porous medium and the flow of electric current through a resistance bed (potentiometric models) or the flow of ions through a solution (electrolytic models). From this we get values such as the classic 72 percent pattern sweepout efficiency for a five-spot injection system.

We knew that the isopotential lines change continuously during most injection operations, and that the pattern sweepout efficiencies could be greater or smaller than 72 percent in a five-spot system. The change in the isopotential lines is a function of the mobilities of the fluids flowing through the reservoir. The mobility of a fluid is defined as the effective permeability of the rock to that fluid divided by the viscosity of the fluid. Mobility can be considered as a measure of the ease with which a fluid can flow. From Darcy's law mobility could be expressed as the linear velocity of the fluid at a pressure gradient of one atmosphere per centimeter.

Effects of Fluid Mobilities

We can show the effect of fluid mobilities on pattern sweepout efficiencies by considering some extreme cases. Fig. 2 shows an element of a five-spot injection system when the leading edge of the injected fluid is about half way between the injection and the producing well. The radial flow out from the injection well (pressure source) tries to keep the advancing front circular in shape while the radial flow into the producing well (pressure sink) tries to pull the nearest point on the front out into a long cusp.

When the mobilities are equal, both wells exert an equal influence on the shape of the front, and it begins to cusp at about the point shown. This leads to a pattern sweepout efficiency of 72 percent. If, however, the mobility of the injected fluid is much lower than that of the reservoir fluid, most of the pressure drop will occur around the injection well. The influence of the pressure source on the front will be much greater than that of the pressure sink. Thus the advancing front will not cusp until it is very close to the producing well and the pattern sweepout efficiency will be higher. Conversely, if the injected fluid mobility is much higher than the reservoir fluid mobility, the pressure sink will dominate the system and the pattern sweepout efficiency will be low.

A mathematical analysis of pattern sweepout efficiency for unequal mobilities is quite difficult and the electric current analogy models are limited to nearly equal mobility studies. We decided to scale down the reservoir to laboratory size and operate it with fluids properly scaled from the reservoir fluids. This principle of building and operating scale models is used in many engineering fields.

Thus, if we take a small piece of porous medium and scale its geometry to that of the reservoir (or reservoir element) and use fluids having correctly scaled properties, we reproduce — in miniature — the pattern sweepout efficiency for the reservoir. In order to see this sweep pattern in the models, we adapted the physician's X-ray equipment. By using a fluid which will absorb X-rays as one of the model fluids, we can use a fluoroscope to trace its movement during a model injection process.

X-Ray Analysis of Reservoir Models

Fig. 3 shows how this X-ray technique works. The model reservoir element is placed in the X-ray beam while the absorbing fluid is injected. A shadow picture is formed on the fluorescent screen that shows which parts of the model contain the injected fluid. For a permanent record, a sheet of photographic film is used instead of the fluorescent screen. A series of X-ray photographs (called radiographs) taken during a scaled injection process shows the sweepout pattern efficiency and how it changes during the history of the process.

Probably the pattern sweepout efficiency most important in reservoir engineering describes the fraction of the reservoir invaded at the time that the injected fluid first reaches the producing well. This is when the oil production rate will start to decline. For a given geometry of the injection system, this pattern sweepout efficiency is a function of only the ratio of the mobility

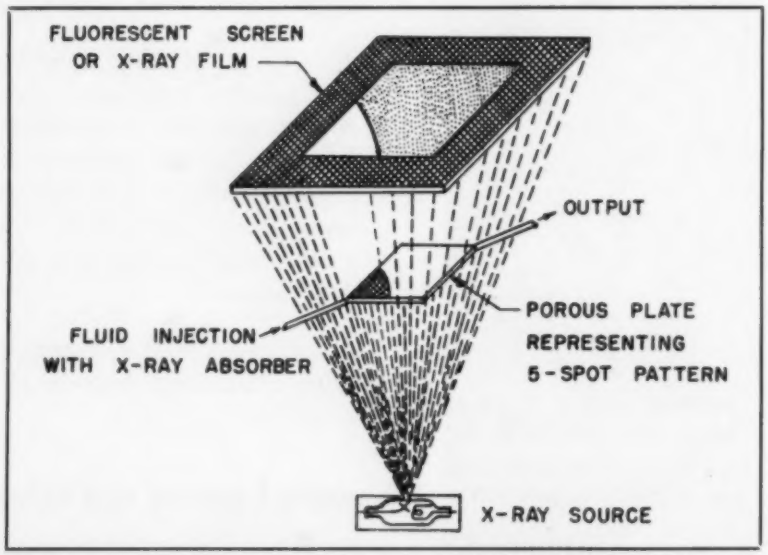


FIG. 3. **X-ray apparatus** for studying pattern sweepout efficiency permits use of fluids having correctly scaled properties in a porous medium representative of the reservoir.

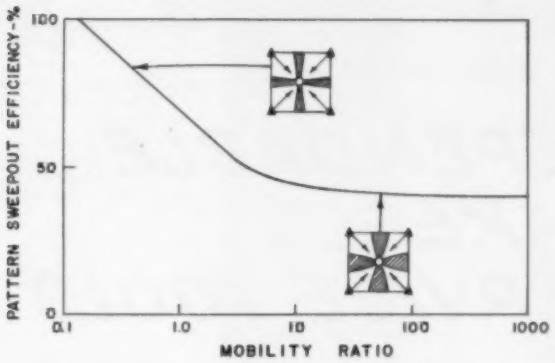


FIG. 4. **Effect of mobility ratio** of injected and reservoir fluids on a pattern sweepout efficiency breakthrough in a five-spot system.

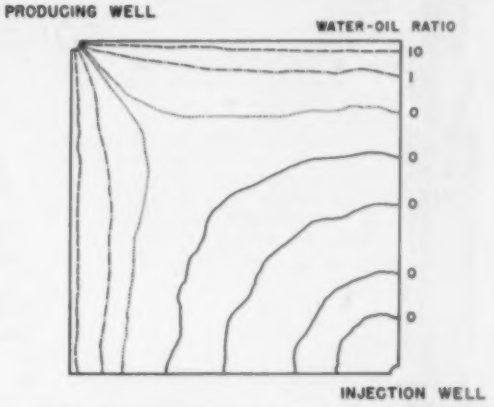


FIG. 5. **Sweepout pattern** at successive stages during a flood of a five-spot pattern at a mobility ratio (mobility of injected fluid to mobility of reservoir fluid) of 1.

of the injected fluid to the mobility of the reservoir fluid. Fig. 4 shows this sweep efficiency at breakthrough for a five-spot injection system. Usually, water floods will have mobility ratios between 0.5 and 2, low-pressure gas drives will have mobility ratios between 1 and 10, while gas-driven miscible displacement processes will show mobility ratios of about 100.

Fig. 5 shows a series of tracings from radiographs made during a modeled water flood of a five-spot injection element. These tracings show that the pattern sweepout efficiency continues to increase even after the water reaches the production well. The frontal outline at the time of breakthrough is shown by the dotted line. The sweep efficiency here is 70 percent.

As injection is continued, both fluids are produced from the well with the oil flow rate declining as the water flow rate increases. At a later time, the pattern sweepout efficiency has increased to 80 percent while the water-oil ratio has reached one. At a much later time the sweepout efficiency is 95 percent at a water-oil ratio of 10:1. A record of volumes injected during the model flood shows that nearly one part volume of water had to be injected after water breakthrough to attain the additional 25 percent sweep.

Fluid Ratio Limits

Normally, reservoirs may be produced economically to water-oil ratios of 20:1 or gas-oil ratios of 25,000. This means that injection operations usually will be continued well past breakthrough. Thus, the total oil recovery will be a function of the pattern sweepout efficiency at these abandonment conditions. Fig. 6 illustrates this for a five-spot injection system. Here we see that, normally, water and low-pressure gas drives will finally sweep nearly all of a five-spot injection system, while miscible gas drives will contact only about 60 percent of the reservoir. Typical unit displacement efficiencies (based on the volume of oil initially in place) are: 65 percent for water drive, 50 percent for low-pressure gas drives, and 100 percent for miscible gas drives.

The unit displacement efficiency must be multiplied by the fractional reservoir volume to be contacted during a secondary recovery process to determine the amount of oil to be recovered. Thus, for the values given above, a water flood would recover 65 percent of the oil originally in place; a low-pressure gas drive would recover 50 percent; and a miscible gas drive would recover 60 percent of the oil. The recovery histories as a function of the volume of fluid injected would look like those shown in Fig. 7. If we forget any economic factors (such as the availability and cost of water or gas) and look only at the ultimate recoveries, we see that the water drive and the gas-driven miscible displacement show nearly identical production histories. This is because the gas-driven miscible process has such an unfavorable mobility ratio.

Miscible Phase Displacement

When the miscible displacement processes were developed, they appeared to be the ultimate in secondary recovery because they would flush all of the oil from the formation which they contacted. However, it was soon realized that the high mobility of the injected gas (because of its relatively low viscosity) created very unfavorable mobility ratios. This meant that the benefit derived from the excellent unit displacement efficiency would be offset by the poor pattern sweepout efficiencies that would prevail. To approach the goal of complete oil recovery the pattern sweepout efficiency of the miscible displacement process must approach 100 percent.

As we have already observed, this sweepout efficiency is determined by the ratio of the mobilities of the injected fluid and the oil in place. For the gas-driven miscible displacement the injected gas region will have a mobility about 50 times that for the displaced oil. It would be very difficult to increase the mobility of the oil since the rock permeability and the in-place viscosity of the oil are fixed numbers. Therefore, the mobility ratio can be improved only by working with the

Ben H. Caudle *received a BS in chemistry with major in organic chemistry from the University of Texas in 1943. Thereafter for a period of four years, he was a petroleum chemist with the United States Bureau of Mines. He joined the Crude Oil Production Division of the Research and Development Department of Atlantic in 1947, and since that time has had a variety of assignments in experimental fluid flow research.*

He is presently Group Leader of an effort involving fluid flow models and studies of reservoir inhomogeneities.

Caudle has written a number of papers in the general field of fluid flow, including the use of X-ray shadowgraph studies of areal sweepout efficiencies and laboratory determination of relative permeability.

SQUEEZE, FRACTURE, ACIDIZE and TEST with these...

DEPENDABLE BAKER SERVICE TOOLS

Here is work-over and re-completion SERVICE as you want it—anywhere, anytime—with seasoned Baker Trained Servicemen and Dependable Baker Retrievable or Drillable Service Tools. Baker provides the right tool, or combination of tools, for *any* job, whether it is routine squeeze cementing; block squeezing in one round trip; performing selective multiple-zone frac jobs in *one* run; acidizing, testing, etc. Bridge Plugs, both Drillable and Retrievable, and a variety of accessories for testing tubing, equalizing tubing/annulus pressures, batch squeezing, etc. round out the most complete line of dependable service tools obtainable.

And the Baker Serviceman, who knows his business because Baker Tools are his *only* business, is always available. His knowledge of local field conditions enables him to make sound recommendations for operations in your well. It pays to start right by calling Baker!

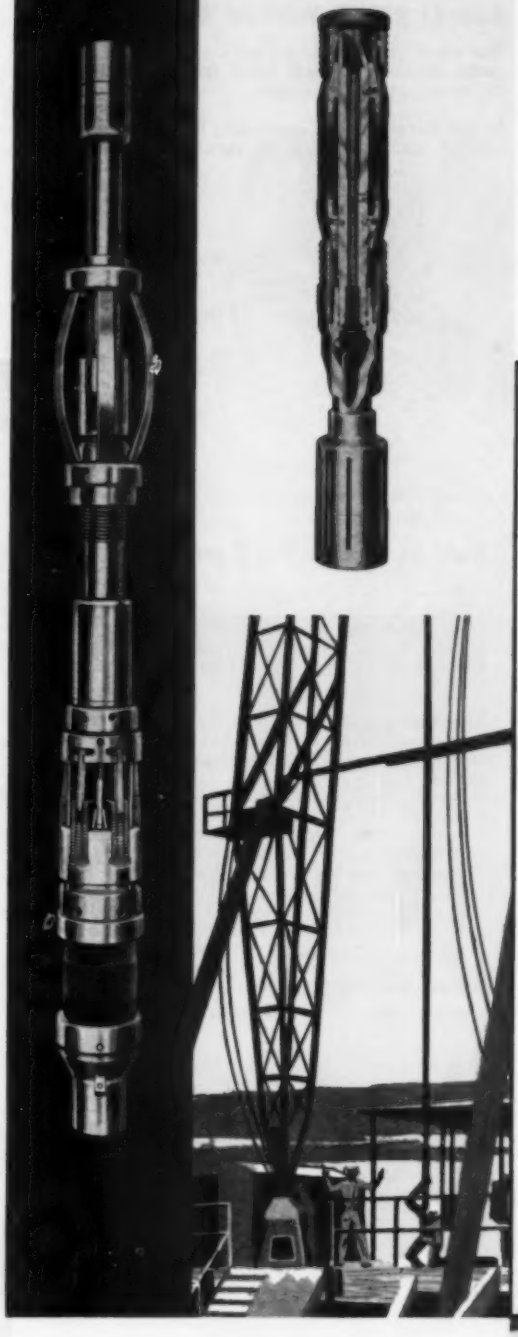
BAKER FULL-BORE RETRIEVABLE CEMENTERS permit running through-the-tubing perforating guns, recording instruments, etc., through and below the tool. Opposed, rocker-type slips and a superior packing element ensure pressure containment from either direction. The ideal "straddle" tool when used with a Baker Retrievable Bridge Plug. Call for Product No. 410.

BAKER RETRIEVABLE BRIDGE PLUGS are dependable, and they hold pressure from either direction. Used alone for plugging casing temporarily under routine or emergency condition, or in combination with other Baker RETRIEVABLE Tools to straddle a virtually unlimited interval. Call for Product No. 677-C.

BAKER FULL-BORE TUBING TESTERS are run with Baker FULL-BORE Retrievable Cementers for safe testing of tubing immediately before squeezing. Right-hand rotation required for setting the Cementer, serves to unlock the Tester Valve; set-down weight closes it; picking-up after testing restores full-opening through the Tester. Call for Product No. 672-N.

BAKER RETRIEVABLE CEMENTERS combine proven performance and real economy for many pressuring operations where a "full-bore" is not required and where excessive pressure differentials from above the tool are not anticipated. Call for Product No. 411-RT.

BAKER FULL-BORE RETRIEVABLE SET-DOWN PACKERS are specifically designed for fracturing and acidizing with subsequent testing. They are packed-off initially merely by setting down weight, and hold pressure from above or below. Call for Product No. 412.



BAKER CEMENT RETAINERS provide the most positive seal possible, with opposed slips that hold securely from either direction. Both the CAST-IRON Type and the MAGNESIUM Type are **readily drillable.** Set on wire line, tubing or drill pipe for a wide range of squeeze operations. Call for Product No. 400.

BAKER WIRE LINE BRIDGE PLUGS are set accurately and positively on wire line. By far the oil country's most popular bridge plug. Made of Cast-Iron for permanent setting or of Magnesium for temporary applications. Call for Product No. 400-N.

When you need SERVICE—call Baker.

BAKER OIL TOOLS, INC.

HOUSTON LOS ANGELES NEW YORK

Tuffy® Wire Rope Tips

More Damage is Done by Broken Rules Than by Broken Strands—

Rule 1: RIGHT WAY to Set Up Reel for Unwinding

The stock reel should be set up on jacks, so the rope will come from the under side of the reel.

In the picture below, unwinding has started and the reel is turning faster than the rope is being pulled off. But no damage is done. Why? Because in coming from the under side of the reel, the rope is simply loosening, without forming loops or kinks.

Tuffy Balanced Standard Rotary Line helped drill the world's deepest well—Wildcat I-EE in Pecos County, Texas. This rotary line is famous for top performance in use with standard rigs in any formation. It also does an outstanding job with jacknife rigs in deep drilling beyond 6000 feet.

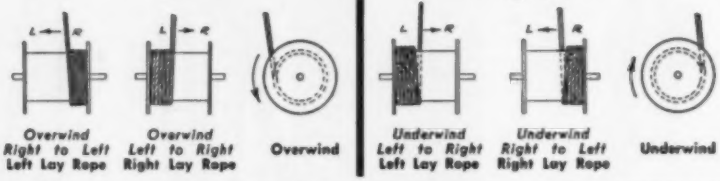
Tuffy Balanced Jacknife Rotary Line: Made to the special needs of jacknife rigs drilling to 6000 ft. Has extra strength, with greater flexibility to move at higher speeds over the smaller sheaves and drums of jacknife rigs, and to give better reeving and spooling.

Rule 4: What's The Correct Lay for Each Type of Winding?

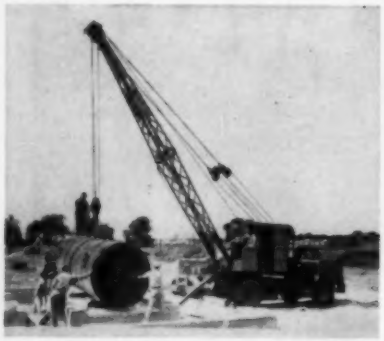
"Lay" refers to the direction of the strands in wire rope. It's a **right** lay rope when the strands pass from left to right across the rope. It's **left** lay when they pass from right to left.

The direction of winding on the drum is determined by standing behind it, looking toward the direction of rope travel.

When winding one layer only on a smooth drum, the right and left lay ropes indicated in the drawings below will give the best service.



Overwind **Right to Left Left Lay Rope** | *Overwind* **Left to Right Right Lay Rope** | **Overwind** | *Underwind* **Left to Right Left Lay Rope** | *Underwind* **Right to Left Right Lay Rope** | **Underwind**



Tuffy Balanced Slings & Hoist Lines This team has made a name for cutting hoisting and downtime costs in all types of materials handling. Tuffy Hoist Line gives the balanced combination of strength and flexibility needed for a longer running rope. Tuffy Slings are made of an extra flexible, high-strength machine-braided fabric that smooths out uninjured after knotting or kinking.

FREE!

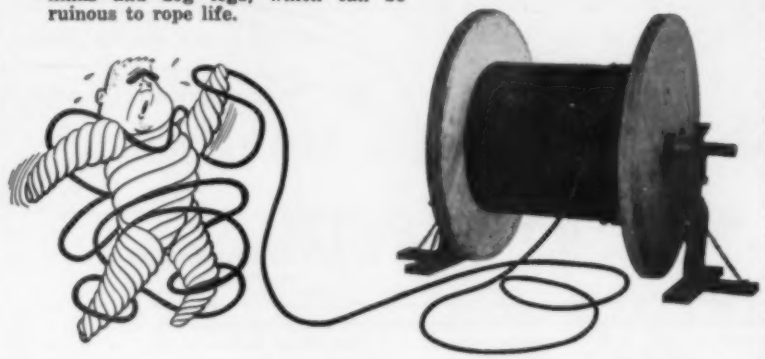
Complete handbook of wire rope use in oil field service

Latest, most complete information ever compiled on the subject in one publication. Shows the various rope constructions used by the oil industry, and gives full data tables on each. Includes (in their entirety) "A.P.I. Specifications for Wire Rope" and "A.P.I. Recommended Practice on Application, Care and Use of Wire Rope for Oil Field Service."

Write Union Wire Rope Corporation, 2106 Manchester Ave., Kansas City 26, Mo. Specialists in high-carbon wire, wire rope, braided wire fabric and stress relieved wire and strand.

Rule 2: WRONG WAY to Set Up Reel for Unwinding

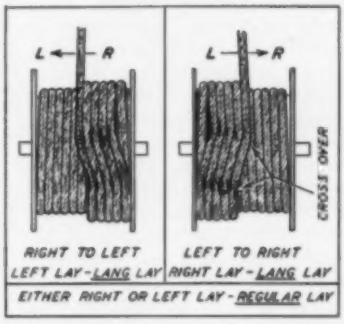
The rope is coming from the top of the reel and forming loops as it overruns. These loops are likely to form kinks and dog legs, which can be ruinous to rope life.



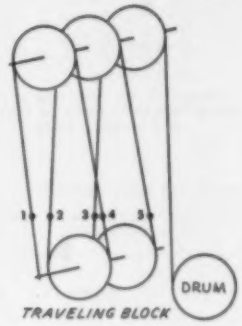
Rope for multiple layer winding: When a rope winds in the first layer across the face of a drum, it usually forms a uniform helix. On reaching the flange of the drum, the rope rides upon the last turn and starts winding back across the face of the drum, but falls into the depression of the successive turns of rope on the first layer.

Advancing across the drum on the second layer, the rope, following the depressions of the first layer, actually winds back a turn in each revolution of the drum. It must then cross over two depressions of the first layer to have a net advance of one turn per revolution.

This cross over is unavoidable on the second and succeeding layers. Severe punishment of the rope results, due to abrasion of the adjacent turns against each other, and the crushing from the next layer above at these points. Parallel-grooved controlled cross-over drums minimize this condition.



Rule 3: How to Figure Reeving Loads



Reeving ropes through the sheaves multiplies the number of parts supporting the load. The lead line to the drum carries the weight of the load lifted, divided by the number of parts, plus the accumulation of friction on all sheaves.

To count the number of parts supporting the load, draw an imaginary line across the parts of the rope supporting the load.

The efficiency of reeving systems ranging from one to eight parts is shown in charts which Union Wire Rope engineers make available to users.

Rule 5: Use the Tuffy Special Purpose Wire Rope "Tailored" to a Specific Application

There was a time when just any size and lay of rope was cut from a stock reel and used for just about any kind of service. It's different today. The various constructions of Tuffy Ropes are precisely fitted to each type of use.

There are thousands of different wire rope constructions. Union Wire Rope makes them all. But there's only one Tuffy line of ropes. Each Tuffy is the right rope and the best rope for the particular work for which it was developed. Each is "job prescribed". Each has the right balance of strength, flexibility and toughness to give you longest service, greatest efficiency and safety.

Union Wire Rope Corporation, Subsidiary of Armco Steel Corporation. Specialists in high carbon wire, wire rope, braided wire fabric, stress relieved wire and strand. 2106 Manchester Avenue, Kansas City 26, Mo.

Your Tuffy Distributor Can Help You Get Longest Service Life and Cut Rope Costs

UNION Wire Rope

New steels are born at Armco

Subsidiary of ARMCO STEEL CORPORATION

OTHER SUBSIDIARIES AND DIVISIONS: Armco Division • Sheffield Division • The National Supply Company
Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Southwest Steel Products

3

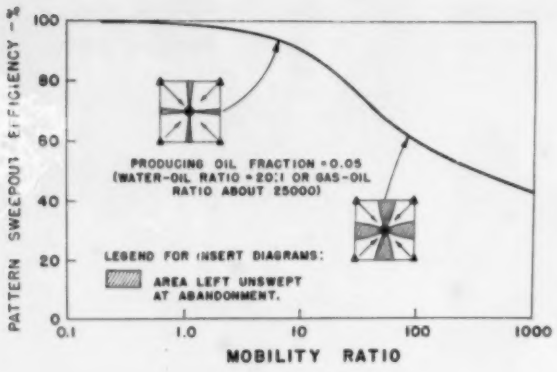


FIG. 6. **Pattern sweepout efficiency** in an injection project continued past breakthrough of injected fluid into producing wells. Such projects can normally be continued economically to a water-oil ratio of 20:1 or gas-oil ratio of about 25,000:1.

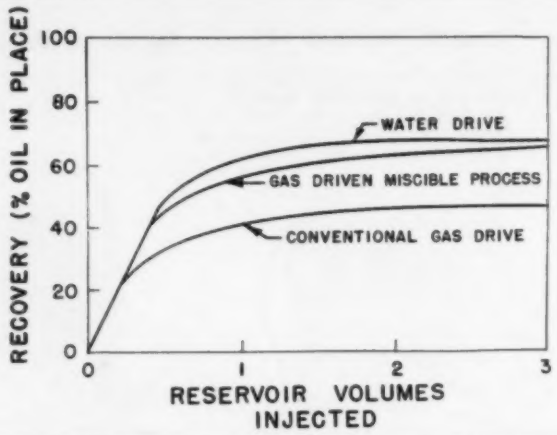


FIG. 7. **Comparison of recovery** histories as a function of fluid volume injected in a conventional system. Varying recovery percentages are due to the different fluid mobility ratios in the three processes.

injected material. Again the rock permeability is fixed but we can inject fluids of higher viscosity and thus lower the mobility in this region as long as we do not destroy the miscible displacement of the oil.

A practical way to decrease the mobility of the injected material would be to inject water (viscosity about 1 centipoise) instead of gas (viscosity about 0.02 centipoise). This, however, would not be a miscible displacement since gas must be the displacing fluid for the process to work. What we can do, however, is to inject a little gas to form the miscible displacement front and follow this with water and gas injected simultaneously.

The inset five-spot pattern in Fig. 8 shows how this will work in a reservoir. The oil is pushed toward the producing well by the band of gas which is miscible with the oil. This gas band (which is actually smaller than shown here) is pushed by water through which flows enough gas to keep the gas band at the proper size. Thus, if the gas band is kept small, the mobility of the water-plus-gas region will determine the pattern sweepout efficiency. This is shown by the curves in Fig. 8. Here we see that the pattern sweepout efficiency will approach 100 percent if the size of the gas band is between 5 and 20 percent of the reservoir volume. Fig. 9 shows the improvement in oil recovery that could be expected in this case.

This is only one example of how our increased knowledge of pattern sweepout efficiencies and their causes have helped in production practices. We have studied systems in which part of the reservoir extends beyond the last row of producing wells. Here we found that much of the oil in this "beyond" region will often be recovered in waterflood operations. We have modeled entire reservoirs when no definite injection pattern could be used, and we are studying pattern sweepout efficiencies for reservoirs containing two or more strata of different permeabilities.

Summary

In summary, let us emphasize the importance of including pattern sweepout efficiencies in predicting secondary recovery processes. We should remember that, in any situation, the sweepout pattern efficiency is controlled by the mobilities of the fluids involved. We should also note that, while we have gone a long way toward understanding reservoir performance, much more work will be necessary if we want to accurately predict sweepout performance in reservoirs which are not uniform in nature. ★ ★ ★

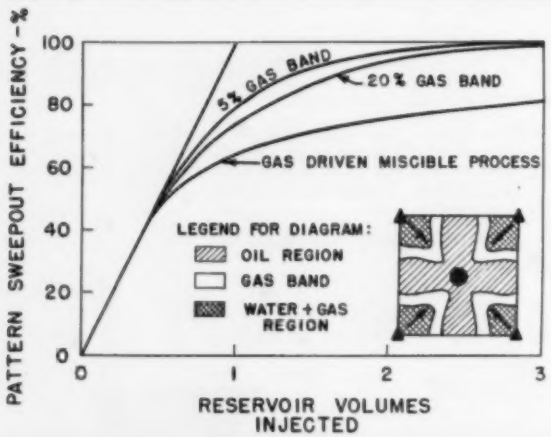


FIG. 8. **Effect of gas-band size** on recovery in the simultaneous water-gas miscible process. Gas is injected to form the miscible displacement front and is followed with water and gas injected simultaneously.

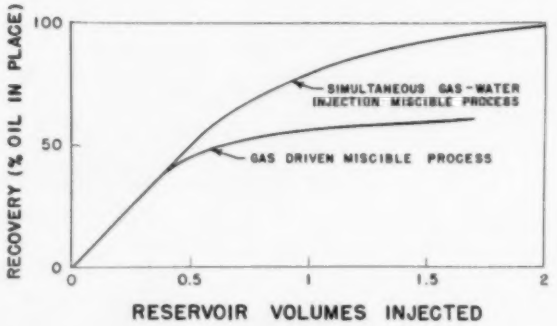


FIG. 9. **Improved recovery** over the gas-driven miscible displacement process is realized with the simultaneous gas-water injection miscible displacement process, taking advantage of improved fluid mobility ratios.

fracturing symposium

Increased Fracturing Efficiency by FLUID-LOSS CONTROL

Asphaltic materials, gums, and insoluble solids — fluid loss additives — permit fracturing fluids to create greater fracture areas, and minimize permeability damage

J. B. Stewart and A. W. Coulter
Dowell Division of Dow Chemical Company
Tulsa, Oklahoma

HYDRAULIC FRACTURING as a method of stimulating well production has achieved industry-wide acceptance over the last 10 years. It has only been in recent months, however, that it has been possible to plan a fracturing treatment based upon accepted engineering procedures.[1] This method of preplanning facilitates choice of fracturing materials and techniques necessary to obtain desired fracture area and corresponding void. To accomplish this, the fracturing fluid is matched with the reservoir to which it will be applied, and the fluid leak-off to the reservoir matrix is expressed as the fluid coefficient.[2]

This fluid coefficient is in effect a measure of the efficiency of a fracturing fluid to create and maintain a fracture. There are three primary methods of determining this fluid coefficient. One method is known as "viscosity control," in which the viscosity of the fracturing fluid is matched with the reservoir characteristics to prevent excessive leak-off. The fluid coefficient is then calculated by use of an algebraic formula. Another method is known as "reservoir-fluid control," in which the viscosity and compressibility of the reservoir fluid control the amount of leak-off. This also is calculated through the use of a formula.

The third method, known as "wall-building control," or more commonly as "fluid-loss control," is the method of controlling fracturing-fluid efficiency that will be discussed herein.

Mechanics of Fluid-Loss Control

The use of fluid-loss additives is not new. They are used in drilling muds to prevent excessive loss of fluid into the formation. This helps maintain uniform drilling-mud consistency as well as minimizing formation contamination. Similarly, in fracturing fluids, such fluid-loss additives prevent the fluid from escaping into the reservoir matrix, thus improving the efficiency of the fracturing treatment.

Fluid-loss additives restrict loss of fluid into the formation by mechanically sealing off formation openings or flow channels. Solid or semi-solid particles are filtered out on the face of the rock as part of the fluid escapes. The resulting buildup forms a relatively impermeable barrier, restricting further fluid passage. This filter cake is dispersed upon reversal of flow when the well is returned to production.

It is evident that if the fluid-loss additive must filter out on the face of the formation, it cannot be soluble in the fracturing fluid. The most effective fluid-loss additives are those which are readily dispersed in the fracturing fluid and, because of the high degree of dispersion, are apparently soluble. They cannot be so completely dispersed, however, that they will escape into the formation.

Because the efficiency of various fluid-loss additives is related to the fluid in which they are used, no one fluid-loss agent can be considered universally satisfactory. As a result, the proper additive must be chosen for each fracturing treatment, depending upon well conditions and the fracturing fluid involved.

In general, fluid-loss agents may be divided into three categories: Petroleum derivatives or asphaltic-type materials; natural or synthetic gums; and insoluble solids.

Asphaltic-Type Fluid-Loss Additives

Probably the simplest fluid-loss additives are the asphaltic type. These have the advantage of being usable in all oil-base fracturing fluids, including emulsions. They have proved effective in refined oil, lease oil, thickened oils, acid-oil emulsions, and oil-water emulsions.

Asphaltic-type fluid-loss additives are characteristically unpleasant to handle. They are incorporated into the fracturing materials in several ways. One of the most acceptable methods has been to blend the additive into the fracturing sand. In some cases, the additive is added at the screw conveyor, where the sand is blended into the fracturing fluid. It can also be blended into a large quantity of fracturing fluid,

Presented under the same title at the Spring meeting of the Rocky Mountain District, API Division of Production, May 6-8, 1959.

or made into a concentrated oil slurry for metered injection in a continuous mixing operation.

Asphaltic fluid-loss agents are most effective in crude oils of low API gravity. They also exhibit greater apparent solubility (actually dispersibility) in these low-gravity crudes.

Two major components of asphalt are neutral resins and asphaltenes. The neutral resins are readily soluble in petroleum, even in high-gravity oils. In contrast, the solubility of the asphaltenes is limited. They are not dispersed in high-gravity crude oils (short-chain paraffinic hydrocarbons), but disperse readily in medium or low gravity crude oils as in Table 1.

TABLE 1. Solubility of Typical Asphaltic Fluid-Loss Additives.

Solvent	Percent Soluble* At 80 F	At 150 F
Pentane	40	—
Kerosine, 43.6 API	68	83
Texas crude, 48.4 API	74	94
Diesel fuel, 35.2 API	76	91
Illinois cypress crude, 35.8 API	79	96
Southern Oklahoma crude, 26.4 API	86	97
Benzene	92	—

*Undissolved portion separated by centrifuge. Colloidally dispersed material was considered soluble in these tests.

The apparent solubility of asphaltenes in medium or low gravity crude results from the adsorption of similar but smaller molecules onto the surface of the asphaltene particle. These molecules tend to pull the particle into the fluid. In the words of Sachanen,[3] "... thus the resins and aromatic hydrocarbons function as peptizing agents which dissolve (colloidally) the asphaltenes."

The asphaltenes are aromatics, and adsorb aromatic constituents of petroleum. High-gravity crude oils contain only a limited number of molecules similar to the asphaltenes. Thus, the adsorption and solubility effect does not occur as readily as in low-gravity crude oils, which contain a greater proportion of aromatic hydrocarbon constituents.

In high-gravity oils, asphaltic materials may be temporarily dispersed by agitation. Apparently, however, this results merely in a solid suspension. In low-gravity crude oils, the asphaltene particles are probably associated in a micellular structure, becoming of sufficient size to filter out against fine pores. The dispersibility of the asphaltic additives results from the stable peptization of these asphaltenes.[4] They will remain completely dispersed at 200 F for over half an hour without agitation, retaining fluid-loss control properties.

Natural and Synthetic Gums

Natural and synthetic gums can be used in aqueous fracturing fluids for fluid-loss control. Such gums are not completely soluble in either water or acid, but form dilute gels (hydrosols).[5] Because they are not in true solution, they are filtered out on the fine pores of the matrix, and restrict the flow of fluid into the formation.

A limitation to the use of natural gums is their rapid hydrolysis, with subsequent breakdown of the gel structure, particularly in acids at high temperatures. As a result very few gums can be used successfully in strong acid.

Where unthickened water is used as a fracturing fluid at high injection rates and low temperatures, such gums can be successfully used. The extent of fluid-loss control depends primarily on the quantity of additive used. Because extremely large volumes are utilized on many of these treatments, cost becomes a major factor in determining the concentration of fluid-loss additive.

Insoluble Fluid-Loss Additives

Insoluble materials can be used as fluid-loss control additives. Apparently their effectiveness depends upon having the proper particle-size range, and upon their being used in conjunction with a gelling agent or agglutinant.[6] Many of the lost-circulation materials used in drilling muds fall into this category, such as plastic flakes, ground nut shells, or vegetable fibers.

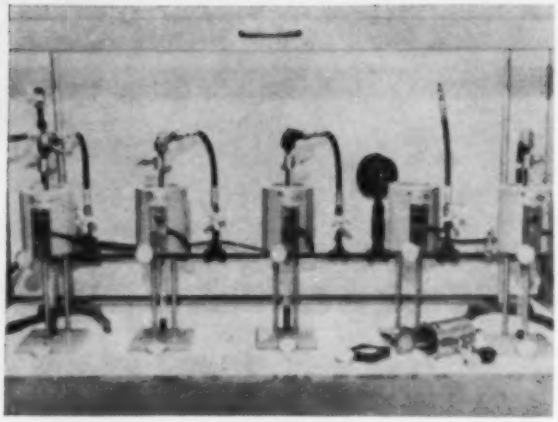


FIG. 1. **Test apparatus** designed to measure the fluid loss of drilling mud samples.

The use of insoluble fluid-loss additives in conjunction with a gelling agent permits designing a material to meet specific requirements. Natural or synthetic gums combined with a small amount of graded insoluble solids provide effective fluid-loss control for water-base fluids. Similarly, in oil-base fluids, an oil-gelling agent or an agglutinant, combined with solid particles, can impart good fluid-loss control.

Most of these insoluble additives are available as powders or granulated solids. Recently, however, such additives have been introduced in slurry form, which can be accurately metered into a fracturing fluid, and are more readily dispersed than a powder.

Measuremont of Fluid Loss

Fluid loss is measured following API RP 29: *Standard Field Procedure for Testing Drilling Fluids,* or similar procedures for high temperature and pressure. The apparatus used in conducting the latter tests is shown in Fig. 1.

These tests were designed to measure the fluid loss of drilling-mud samples, but have been adopted for fracturing fluids. The fluid is placed under pressure in a closed cham-

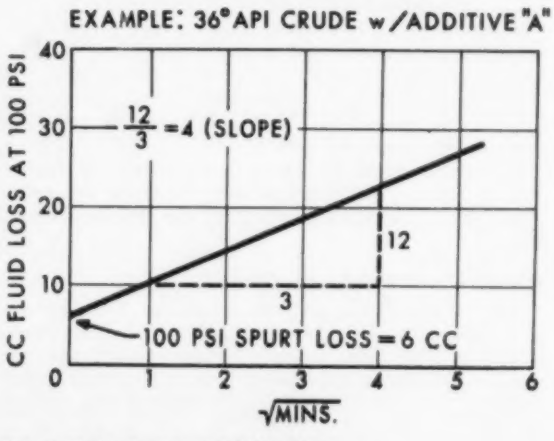


FIG. 2. **Typical plot** of fluid-loss data.

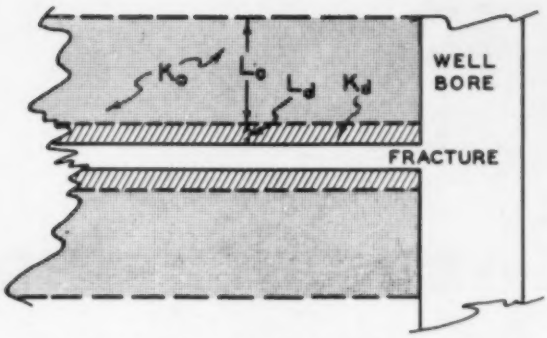


FIG. 3. **Lineal flow** into a fracture is described. L_o represents the undamaged zone; L_d, the damaged zone.

ber, at the bottom of which is a fine filter paper (Whatman No. 50) through which the fluid can escape. This paper does, however, retain dispersed particles. The amount of fluid passing through the paper is measured at various time intervals. This fluid loss is usually expressed in terms of cu cm per 30 min. The fluid coefficient of a wall-building or fluid-loss controlled fluid may be calculated from these data. The cumulative filtrate volume is plotted vs the square root of flow time. The coefficient is then calculated from[2]:

$$C\ 0.0164\frac{M}{A}, \frac{ft}{\sqrt{min}}$$

Wherein:

C = fluid coefficient, $^{ft}/\sqrt{min}$.

M = slope of fluid-loss curve, $^{cc}/\sqrt{min}$.

A = area of filter media, sq cm.

A typical plot of fluid-loss data is shown in Fig. 2. The fluid-loss test should be run at the bottom-hole temperature and calculated fracturing-differential pressure. If tests are run at lower pressures, proper corrections must be applied. It is then possible to determine expected fracture area which will be obtained using this fracturing fluid.[1]

It has been shown in the laboratory that the fluid loss through filter paper is not necessarily the same as that through formation cores, as shown in Table 2.

Filter paper is essentially two-dimensional, whereas the formation is three-dimensional. The greater length of flow channels that the fluid must travel through in the matrix has a definite influence on the amount of fluid lost into the formation. In general, highly viscous fluids (especially emulsions) will have a much lower fluid loss in a fracture than would be indicated by filter-press tests. In contrast, fluid-loss additives carried in a non-viscous fluid yield comparable fluid-loss data through either filter paper or rock.

TABLE 2. Comparative Fluid-Loss Tests.

Type Fracturing Fluid	Fluid Loss at 100 psi Through		
	No. 50 Whatman Paper, API RP 29	Rock Core, 1-in. Thick 3½-in. Diameter	Rock Core, 3-in. Thick 3½-in. Diameter
Acid-in-oil emulsion	300 ml per 34 sec	25 ml per 30 min	0 ml per 30 min
Acid-in-oil emulsion with fluid-loss additive	12 ml per 30 min	2 ml per 30 min	0 ml per 30 min
Oil-in-water emulsion	300 ml per 41 sec	210 ml per 30 min	80 ml per 30 min
Oil-in-water emulsion with fluid-loss additive	141 ml per 30 min	185 ml per 30 min	25 ml per 30 min
Thickened oil	300 ml per 5 min	300 ml per 30 min	—
Thickened oil with fluid-loss additive	11 ml per 30 min	1 ml per 30 min	—

Formation Damage

Following a fracturing treatment the greatly increased drainage area, represented by the newly opened fracture faces, results in increased well production. This production increase may be limited by the damaged permeability resulting from fluid penetration into formation capillary flow passages. If maximum stimulation is to result from a fracturing treatment, penetration should be held to a minimum.

Such damage can be minimized by the use of fluid-loss control additives. The resulting productivity is increased because the depth of penetration of the fracturing fluid is lessened. Laboratory tests on core samples have shown that the use of a fluid-loss additive reduced permeability damage resulting from fluid penetration.

This also can be shown by calculations based on Darcy's law:[7]

$$Q = \frac{KA\Delta P}{\mu L}$$

Wherein:

Q = flow rate.
K = permeability.
A = cross-sectional area.
ΔP = pressure differential.
μ = fluid viscosity.
L = length of drainage path.

Assuming a unit area, and constant viscosity, the equation can be reduced to the proportion:

$$Q \cong \Delta P\frac{K}{L} = \Delta P\frac{1}{L/K}$$

In other words, flow is proportional to the pressure differential times the reciprocal of the resistant to flow. For the purpose of calculating the flow into a fracture, lineal flow may be considered, as shown in Fig. 3,

wherein:

K_o = permeability of undamaged zone.
K_d = permeability of damaged zone.
L_o = length of undamaged zone.
L_d = length of damaged zone.

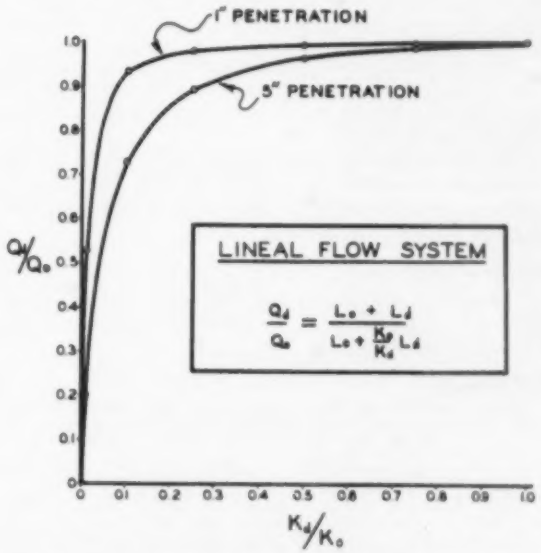


FIG. 4. **Comparison** curves of permeability damage of 2-in. fluid penetration and 5-in. fluid penetration into a 120-in. zone.

$L_o + L_d$ = total depth of drainage zone.

Q_o = flow through zone, if no damage had occurred.

Q_d = flow through damaged zone.

In this example the flow would be through the undamaged and damaged zones in series, and the resistance to flow is assumed to be additive.

$$Q_d \cong \Delta P \left[\frac{1}{(L_o/K_o + L_d/K_d)} \right], \text{ flow after damage}$$

$$Q_o \cong \Delta P \left[\frac{1}{\frac{(L_o + L_d)}{K_o}} \right], \text{ flow before damage}$$

Therefore the ratio of flow after damage to flow before damage would be:

$$\frac{Q_d}{Q_o} = \frac{\Delta P \dfrac{1}{(L_o/K_o + L_d/K_d)}}{\Delta P \dfrac{1}{\dfrac{(L_o + L_d)}{K_o}}} = \frac{\dfrac{L_o + L_d}{K_o}}{\dfrac{L_o}{K_o} + \dfrac{L_d}{K_d}}$$

$$\frac{Q_d}{Q_o} = \frac{\dfrac{L_o + L_d}{K_o}}{\dfrac{L_o K_d + L_d K_o}{K_o K_d}} = \frac{(L_o + L_d)\, K_o K_d}{K_o (L_o K_d + L_d K_o)} = \frac{(L_o + L_d)\, K_d}{L_o K_d + L_d K_o}$$

$$\frac{Q_d}{Q_o} = \frac{L_o + L_d}{L_o + \dfrac{K_o}{K_d} L_d}$$

The depth of penetration of the fracturing fluid is a major factor in determining the degree of damage to the productivity of the well.

For example, a comparison of the permeability damage of 2-in. fluid penetration and 5-in. fluid penetration into a 120-in. zone is shown in Fig. 4.

Assuming that the permeability had been reduced 90 percent, then K_d/K_o would be 0.10 or K_o/K_d would be 10. It may be seen that the production capacity would be decreased 27 percent if the fluid penetration amounted to 5 in. and only 7 percent if the penetration were limited to 1 in.

Conclusions

The efficiency of fracturing fluids may be increased by the use of fluid-loss control additives. The effectiveness of such modified fluids should be taken into consideration in planning fracturing treatments.

During a fracturing treatment, permeability damage to the matrix can be minimized by controlling fluid penetration by means of fluid-loss additives. This, in turn, results in maximum productivity increases.

Acknowledgement

The authors wish to express their appreciation to C. D. Hall and C. L. Wendorff for valuable assistance in the preparation of this paper.

References

1. Hurst, R. E.: An Engineered Method for the Evaluation and Control of Fracture Treatments, Paper No. 851-33-J presented at the Mid-Continent District Meeting, Division of Production, Amarillo, Texas, April 22-24, 1959.
2. Howard, George C., and Fast, C. R.: Optimum Fluid Characteristics for Fracture Extension, *Drilling and Production Practice*, 261 (1957).
3. Sachanen, A. N.: *The Chemical Constituents of Petroleum*, Chap. 9.
4. Bauer, Walter H.; Wilberley, Stephen E.; and Weber, Neill: Flow Properties and Structure of Peptized Aluminum Soap-Hydrocarbon Gels, Paper No. 46, Division of Colloid Chemistry, American Chemical Society, 131st Meeting, Miami, Florida, April 7-12, 1957.
5. Mantell, C. L.: *The Water Soluble Gums*.
6. Brown, Jack L., and Landers, Mary M.: Low Fluid Loss Composition, Patent No. 2,779,735 (Continental Oil Co.).
7. Muskat, Morris: *Physical Principles of Oil Production*.

★ ★ ★

ENGINEERING

R. G. Martin and P. W. Arnot
Dowell Division of Dow Chemical Company
Evansville, Indiana

WELL STIMULATION TREATMENTS have become an essential factor in the economical recovery of oil and gas from underground reservoirs. Unfortunately, in spite of all precautions, disastrous accidents have occurred in the past and will undoubtedly occur in the future, resulting in loss of life and property. Such incidents are indeed tragic. Investigations following many of these incidents have disclosed weaknesses and danger spots that can be overcome by new designs or equipment layout.

Oilfield engineers have recognized the ever-increasing hazards attending today's varied and complex well stimulation treatments. As a result, in addition to their efforts in developing new and improved equipment and techniques, sound preventive safety principles are being incorporated in an effort to reduce the waste of oilfield accidents.

Increased job safety is being obtained through a number of approaches: Discriminate personnel selection, adequate safety training, safety-engineered equipment design, thorough equipment inspection, improved treating procedures, conscientious job performance, and thorough accident investigation with attendant corrective measures.

Personnel Selection

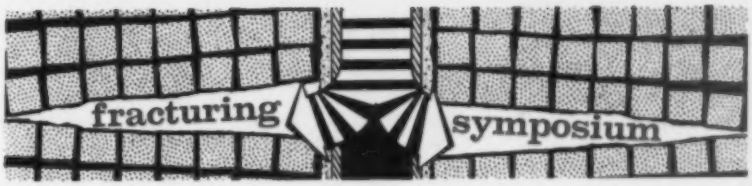
The most thorough safety program is no better than the men who carry it out. Therefore, the first step in reducing accidents is to try to hire conscientious, intelligent workers who will observe proper precautions, and anticipate possible hazards. This selection is aided by the use of carefully planned hiring procedures.

Preliminary interviews help determine the suitability of a prospective employee. Standard personnel data include previous work history, education and training, family background, domestic and social situation, and health record. In addition, standard aptitude tests determine what the applicant can do, and for what type of employment he is best qualified. A physical examination will usually detect possible physical defects that might make him an unsafe employee.

Safety Training

All new employees should receive training, not only in their new job duties but in accident prevention. Such indoctrination should be under the direction of a qualified engineering department.

Progressive safety training for oilfield well stimulation service includes orientation in station routine, coaching in safe handling methods and proper on-the-job procedures. Employees receive an accident prevention handbook, describing safety equipment to be used on the job, and discuss-



SAFETY Into Well Stimulation Work

Responsibility for safe, efficient well stimulation treatments belong to everyone participating! Built-in safety factors cannot take the place of safety planning and practices on the job — adhered to by every individual at the well site

ing the proper use of protective devices, such as safety hats, safety shoes, goggles and other protective clothing.

The general development program for equipment operators is a continuing process and includes training in general safety and accident prevention, as well as basic first-aid instruction. Elementary and advanced driving, on the road or on location, and proper vehicle care all are stressed. This includes safety maintenance checking of all truck and automotive equipment, and auxiliary gear. Proper use of hand tools, handling and storing treating materials, mixing and loading hazardous chemicals, are all a part of this development training program.

Supervisors of new employees make reports on the progress and efficiency shown, both in job performance and safety education. This evaluation is used to rate personnel, and to determine improvements needed in the training program. Poor ratings on any particular item indicate the necessity for repetition of these specific subjects, and show where strengthening of the training program is required.

Equipment Design

New concepts of design and engineering have resulted in the development of service equipment capable of greater capacity and efficiency. Equally important has been the development of special safety measures, built into pumps, controls and fittings.

As fracturing treatments became larger and more complicated, higher injection rates resulted in increased horsepower requirements, larger numbers of pumping units became necessary, and multiple wellhead connections grew more and more complex. This greatly increased the possibility of equipment failure. To minimize this potential hazard, a new simplified "frac header" and discharge system has been developed for high injection rate treatments. This device offers increased safety, durability and convenience. Causes of failure, prevalent in other headers, have been minimized by design features of this unit.

Essentially, the header consists of three basic component parts: (1) Casing adaptor, (2) cross, and (3) goat head. The casing adaptor is machined either to fit a combination flange or to screw directly into the casing. A 2½-in. union outlet is provided that may be used for bleeding off pressure or injecting perforation ball sealers.

The cross is used where more than three treating lines are to be tied into the well. Any number of these units may be assembled to provide increased hook-up capacity.

The goat head is a three-way adaptor. The union connections are machined to eliminate unnecessary nipples and connections. Each goat head contains a check valve which is an integral part of the unit, designed to handle 60 bbl per min flow with minimum friction loss. Each goat head is capable of handling the output of three pump trucks.

An additional component sometimes used is the top plug. This unit facilitates handling and installation of the header, as well as providing an opening for wire line operations, without disturbing treating line connections.

This header provides many advantages. It is versatile, permitting as many different combinations as may be required, ranging from small, one-truck treatments to large treatments requiring 12 or more trucks. It is constructed to allow maximum fluid flow, which reduces friction losses and minimizes the erosive action of sand-laden fluids. The disassembled component parts can be readily inspected.

This header is designed for maximum strength and durability. It is made of cast AISI 8630 steel, heat treated to a Brinell hardness of approximately 255, meeting federal specification No. QQS-681B. Each unit is tested in accordance with ASTM specifications E71-52 and E109-55. It has a tensile strength of 120,000 psi and a minimum yield strength of 100,000 psi. All welding has been eliminated.

Treating pipe has also been strengthened in order to meet more drastic pressure requirements. In many cases 2⅜-in. OD pipe that was formerly used has been replaced by a 2½-in. ID and 3 1/6-in. OD tubing, of type AISI 4140 alloy steel. This increase in treating pipe size has reduced friction losses and prolonged the safe, useful life of the discharge system.

Remote control panels are another engineering development designed to provide safer, more efficient operation and control of the multiple, high power pumping units used in today's high-injection-rate fracturing treatments. These control panels provide starting and shut-down operations, up to 125 ft from the pumping unit. Multiple dials show operating conditions of the engine, torque converter and pump, as well as treating pressures and volumes. In addition, safety features such as fire control, pressure control and volume control are provided. The operator of the unit can regulate his pump from a relatively safe area, removed from the well head and equipment, so that an overall view of the operation is possible.

In addition to the many large size pumping units and their heavy-duty engines, auxiliary blenders, mixers and sand proportioners are also used on many large size treatments. The noise level, resulting from all this equipment being in

•Presented, under the same title, at the Spring Meeting of the Eastern District, API Division of Production, Pittsburgh, Pennsylvania, April 8-10, 1959.

operation, has made the problem of communication and coordinated control very serious.

Many devices and systems have been tried to overcome this problem, and some are in use today. The loud-speaker or head-set telephone closed circuit methods have the disadvantage of restricted mobility, and are not always dependable under adverse weather or sound conditions. Hand signals, or a system of colored lights on a control board, also have distance and visibility limitations.

The latest engineering advancement now being tested, uses a short-wave radio receiver-transmitter-battery combination, built into a fiberglass safety helmet. The whole assembly weighs only 2½ lb. The range of this miniature unit, made possible by the use of transistors and printed electrical circuits, is about 1000 ft. The microphone is located on the chin strap, and is designed to filter out engine sound. Ear phones are also specially designed to eliminate outside noise. FCC type acceptance and a license for this type helmet has been received and this communication device is now being tested under various weather and service conditions to determine its effective limits.

Equipment Inspection

An important phase of accident prevention is the inspection of equipment, to detect and correct potential safety hazards before they become serious. By maintaining equipment in top operating condition, maximum efficiency and safety during use are assured.

Vehicle inspection is essential to the proper maintenance of mobile equipment. A qualified supervisor should make checks on the condition of all vehicles. Such inspection should cover mechanical and electrical systems, lubrication, hydraulic systems, auxiliary safety equipment and general appearance.

In addition, pumps and auxiliary treating equipment should undergo frequent, rigid inspection. This is particularly important on equipment which must be operated at high-pressure levels.

Constant visual inspection and pressure testing is also desirable to insure the continued safe operation of equipment components. Such checking is done both at the station and on the job. A visual inspection of all important parts is conducted to detect erosion, cracks or other weaknesses occurring as the result of continued use. On location, surface piping is subjected to pressure testing in excess of anticipated job requirements, to detect leaks that might develop during the fracturing treatment.

All worn or damaged equipment detected during such inspections is discarded and replaced.

Treating Procedures

Of equal importance to designing and maintaining equipment for maximum safety, is the establishment of safe practices and working procedures. Here again, sound engineering principles may be applied to eliminate unnecessary hazards and assure safe, efficient operation. Well operator's, contractor's and service personnel are equally responsible for adherence to proper safety regulations, and only by intelligent cooperation can maximum safety be attained during well stimulation operations.

A special API report will soon be available which describes in detail the recommended procedures and precautions to be observed during fracturing treatments. This report was compiled through the experience and cooperation of many well operators and several leading service organizations. It includes information concerning:

1. Preparation of well locations,
2. Location of supply tanks,
3. Choice of fracturing fluids,
4. Proper positioning of service equipment,
5. Design of treating lines, connections, and well-control devices,
6. Control of potential fire hazards,
7. Preliminary testing of treating lines, connections and instruments,
8. Specifications for wellhead control equipment,
9. Holding pre-treatment safety meetings.

The principal safety objective on any well stimulation job is the control of fire hazards. Recognition of such hazards by all personnel on the job is the biggest factor in eliminating accidents, and protecting personnel and equipment.

Job Performance

The most careful planning and elaborate precautions are useless, if they are not followed during the performance of a job. Most workers are intelligent enough to recognize the dangers involved in their work, but sometimes, either through haste or over-familiarity, may tend to ignore them. The practice of safe working principles on the job must be the constant desire of every workman.

A valuable reminder before any well stimulation job is a "tail gate" safety meeting, to discuss the treatment in detail. At this time, hazardous conditions can be pointed out and any misunderstandings or misinformation cleared up. Wherever possible, safety hazards should be eliminated, but where this is impossible, all personnel should be made thoroughly aware of the danger and full instructions issued for possible action to be taken in the event of an emergency. Such meetings not only provide increased safety, but also result in improved job performance.

The importance of "checking up" before the job cannot be overemphasized. All connections should be checked for leaks or improper hook-up. Instructions should be given concerning safe smoking areas and times, and necessary measures taken to control spectators.

Accident Investigation and Correction

In spite of all precautions, accidents do occur from time to time. These can, however, be made a source of profit as well as loss. By thoroughly investigating the conditions surrounding the event, and determining the possible cause, it is often possible to take corrective measures which may prevent its future recurrence.

Detailed reports should be made in the event of any automotive accident or personal injury. Such report should include a description of all personnel and equipment involved, the time, place and weather conditions, how the accident happened, names of witnesses, conditions that contributed to the accident, measures which might have prevented the accident, and recommendations for future corrective action. Such recommendations may be for:

1. Disciplinary action,
2. Equipment design change or improvement,
3. Additional safety education or re-emphasis of a particular phase of the safety program.

All failures of treating tools or equipment components should be investigated in a similar manner. Lab analysis of broken parts are often conducted to determine the cause and, where possible, permit modification and improvement of design or workmanship.

Summary

Increased job safety is a vital, worthwhile goal. It can be attained only through intelligent, constructive planning and follow-through. Posters and slogans are not sufficient. Safety must be engineered into every well stimulation job from start to finish. It is not the responsibility of one or two individuals alone, but requires the whole-hearted cooperation of everybody on the job, well operator, contractor and service company personnel alike. ★ ★ ★

MOST IMPORTANT ADVANCES IN PUMP DESIGN IN 30 YEARS!

WHELAND *PLANETARY* HP-16000 SLUSH PUMP

DUPLEX POWER SLUSH PUMP 7¾" x 16"
600 HP at 65 RPM

U. S. Patent 2,649,988 and 2,717,186. Other patents pending.

NOW! **FOR THE FIRST TIME . . .**
these proven mechanical principles are applied to a slush pump!

- **PLANETARY GEAR SYSTEM**
  with gear cartridge assembled and inserted as a unit.
- **CROSSHEAD IS A PERFECT CIRCLE**
  thus stays perfectly aligned in every direction.
- **FLOATING INPUT SHAFT**
  with unique sheave mounting which lets shaft transmit torque load ONLY.

Three years in designing, developing and in final field testing are behind this newest, most advanced WHELAND 16" PUMP. A folder giving the highlights of this new pump is yours for the asking . . . or we can give you current locations so you can see it in operation. You can't afford to buy any pump in this size until you've seen this new Wheland pump!

WHELAND

ROTARY DRILLING MACHINERY

THE WHELAND COMPANY
CHATTANOOGA, TENNESSEE, U.S.A.

DRAW WORKS • SLUSH PUMPS • ROTARIES
CROWN BLOCKS • TRAVELING BLOCKS • SWIVELS

DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC.—Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC.—Main Office: Houston, Texas • JONES AND LAUGHLIN STEEL CORPORATION, SUPPLY DIVISION—Main Office: Drawer 2481, Tulsa 2, Oklahoma.

EXPORT DISTRIBUTORS: LUCEY EXPORT CORPORATION—233 Broadway, New York 7, New York—Broad Street House, London, E. C. 2, England.

fracturing symposium

Are You Considering All the Factors in Designing a Fracturing Treatment?

Hugh J. Ayres **W. T. Malone**
Halliburton Oil Well Cementing Company
Duncan, Oklahoma

There are still some significant aspects involved where absolute values cannot be assigned. Field experience and good operating practices serve as valuable guides

THE MOST important thing in the life of any producing well may be the stimulation treatment to which it is subjected. Since a large percentage of wells drilled are actually non-commercial producers until stimulated in some fashion, design of the well should facilitate the fracturing treatment that is to be performed upon it. This requires selection of the stimulation treatment by the well operator before the original plan for the well is completed. Striving for a particular type of stimulation treatment while the well is being drilled and the casing run will be helpful at a later date.

Many advances in well stimulation treatments have been introduced recently. These advancements when used in conjunction with proved techniques may produce better results. While economy is quite important, the future production of a well should not be impaired by the use of questionable techniques.

In many instances the production from a well may have been hindered by improper mud control and lack of good cementing techniques. These particular points may not have been due to negligence but rather to improper knowledge of reservoir conditions. The production increase in many cases following stimulation is believed to result from breaking through the barrier immediately adjacent to the well bore.

Improved knowledge now available to industry in almost all phases of well completion and stimulation makes possible a better pre-treatment design and should result in better production for a longer sustained period of time. However, all the factors involved must be considered if sustained production is to be obtained through stimulation techniques. It is the intent of this article to point out some of the many factors which are necessary in pre-treatment design for a particular well.

DESIGNING A WELL FOR STIMULATION

If casing of adequate strength and size is installed in a well, the cost of stimulation treatments may be substantially reduced. Savings include lower cost for fracturing horsepower, rental tools and rig time necessary to run tubing into the well. This reduction in cost may at times partially or wholly offset the increased cost of drilling and setting proper casing in the well.

Condition of Mud

Proper mud conditioning is extremely important because of the phenomenon known as "skin effect" or formation damage. The same damage can result from improper cementing techniques. If either mud or cement or the filtrates from them invade the formation, a localized plugging condition may result. Both the mud and cement program should be selected with care.

If either drill pipe or casing is lowered too rapidly, while the potentially productive formation is exposed, the resultant pressure surge may also cause harmful effects. In some cases, fracturing can result from such surges and large quantities of drilling fluid or cement may be lost into the zone of interest.

How the Well Is Perforated

Since the effectiveness of any fracture treatment may be dependent upon the manner in which the well is perforated, it is good practice to selectively perforate each zone.[1,2,3] Prior to the introduction of fracturing, it was considered desirable to have a high perforation density to expose as much of the producing formation as possible. By utilizing present-day methods of well stimulation the problem of exposing area has been simplified. The perforation pattern should be planned to provide access to the best points of possible production as indicated by logs. A sufficient number should be provided to accommodate the desired injection rate.

Channeling and communication. Perforation of the total zone with high density may shatter the cement sheath between the casing and the formation. Such shattering may result in channeling or communication between sections and make multiple treatments by hydraulic fracturing difficult. There are instances recorded when hydraulic fracturing failed due possibly to communication with a completely

barren zone. The only reason now for any appreciable number of perforations is to provide access for stimulation. A very small number of properly placed perforations can provide adequate drainage for a large percentage of the wells drilled today.

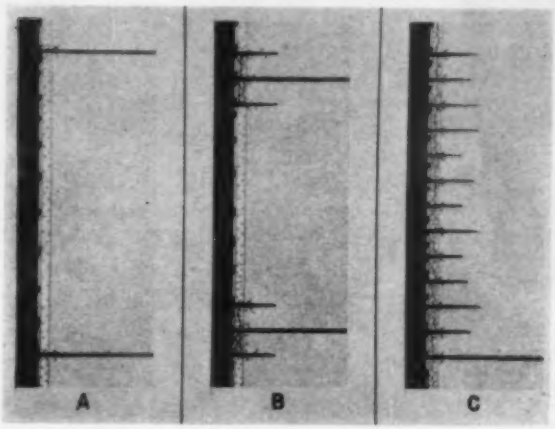


FIG. 1. **Possible perforating patterns.**[3] "A" is probably adequate for drainage. "B" provides better access for stimulation. "C" is less desirable for effective isolation since cement may be damaged.

INFORMATION NEEDED TO PRE-DESIGN A FRACTURE TREATMENT

Prior to designing a fracturing treatment, much information about the well is needed. This information is available from core analysis, X-ray analysis, compatibility tests, drillstem tests, electric logs, previous treatments in the area and other sources.

Core and X-Ray Analyses

A core analysis will usually furnish permeability, porosity, salt content, solubility, and fluid saturation. From the solubility characteristics, the desirability of using acid and the proper type of acid may be determined.

By performing an X-ray analysis, the presence of water sensitive clays and other minerals may be detected. An indication of the proper fracturing fluid to use may be given by the presence or absence of such materials. For example, if a core contains large amounts of montmorillonite, it may not be desirable to use a fresh water base fracturing fluid due to the swelling characteristics of this type of clay. With proper additives, water may be made safe for many reservoirs.

Fluid Compatibility

The various possible fracturing fluids available should be checked for compatibility with the core and with the reservoir fluids. It is extremely important to minimize the formation of secondary emulsions or release of fines which may tend to impede the flow of fluid through the fracture. These tests will reveal the proper surfactants and chemical controls to incorporate in the treatment to help prevent such effects.

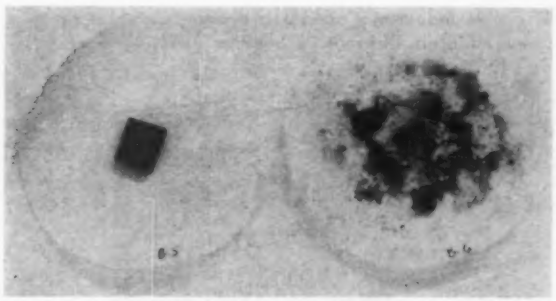


FIG. 2. **Effect of immersion of core segments.** At left, segment was placed in 15 percent hydrochloric acid while segment at right was immersed in 6 percent hydrofluoric acid. Fluids which might be injurious to formations may be eliminated from consideration by this method.

Drillstem Test Data

When cores are unavailable, it is frequently possible to obtain permeability, porosity, bottom-hole pressure and temperature, saturation of fluids and transmissibility from drillstem tests and/or electric logs.

It is believed that in many wells there is a zone of damage or some skin effect that may be resulting in low production. The cause of the damage, as mentioned earlier, may be drilling fluid or cement encroachment or possibly actual physical damage caused by drilling tools. A good method of looking at the damage ratio is through the use of drillstem testing techniques.[4]

Transmissibility factor. Interpretation of drillstem testing charts may show the ability of a particular well to transmit fluid from the formation into the well bore. This relation is called the transmissibility factor. The transmissibility, when found from the interpretation of the testing chart, may be used to calculate the productivity index and the damage ratio. Usually, when the damage ratio is unity the well is considered to have no damage. A damage ratio above unity is an indication as to amount of damage. Results of this analysis can be very useful in determining whether a chemical removal might result in sufficient production increase or whether a fracturing treatment is probably necessary. In many cases, it can be used in deciding the need of chemical treatment prior to fracturing.

Exposed Pay Interval

Information should be available concerning the type, size, number and location of perforations. If an open hole completion has been employed the casing point and total depth must be known. In either case the total net (productive) pay should be specified.

Treatment Experience

Previous treatment records may furnish valuable information to assist in the design of future fracturing treatments. Old pressure charts may furnish valuable information regarding treating pressures, while fluid and sand volumes may be useful in predicting results.

Some of the information discussed above is essential to the proper design of a treatment. If all of the information is available, the possibility of a successful treatment is greatly improved.

DESIGN OF THE FRACTURING TREATMENT

A method was developed in 1957 by Howard and Fast[5] for calculating the area of a fracture. This calculation was based on (1) injection rate, (2) fluid efficiency and (3) rate of fracture growth.

Fluid efficiency is an important part of the area calculation and is defined as the resistance of the fluid to leak-off into the formation matrix. Once the fluid efficiency has been determined (either by calculations or laboratory tests) and other parameters specified, the probable area of the fracture can be calculated. For best results, it is desirable that the fracture be packed completely with sand. This amount of propping agent may be determined directly from fracture volume.

Friction Loss

Placement of the propping agent is probably the most important thing in the actual fracturing treatment. To maintain the calculated pump rate during fracturing, it is neces-

There's only ONE

TARSET®

Coal Tar-Epoxy Resin Coating

IF you're confused by the number of coal tar-epoxy resin coatings on the market today, perhaps these few brief facts will clear the air:

1. Pitt Chem TARSET is the *first* patented coal tar-epoxy resin coating on the market.

2. No other coal tar-epoxy resin coating duplicates the exclusive TARSET formula. It has not been made available to anyone else.

3. Only TARSET coal tar-epoxy resin coating is backed by a *five year* record of outstanding performance in the field.

Do *you* have an unusual corrosion problem in the marine, chemical, petroleum, pulp and paper, water and sewage, or general plant maintenance field? Then you should know more about the revolutionary ability of TARSET to stop corrosion where most other practical methods fail. And to do it at relatively low cost. *Call your industrial distributor for more information . . . today!*

★ PITT CHEM "Tarmastic"® Coal Tar Coatings
★ PITT CHEM "Insul-Mastic" Gilsonite Coatings
★ PITT CHEM "Tarset" Coal Tar-Epoxy Coatings

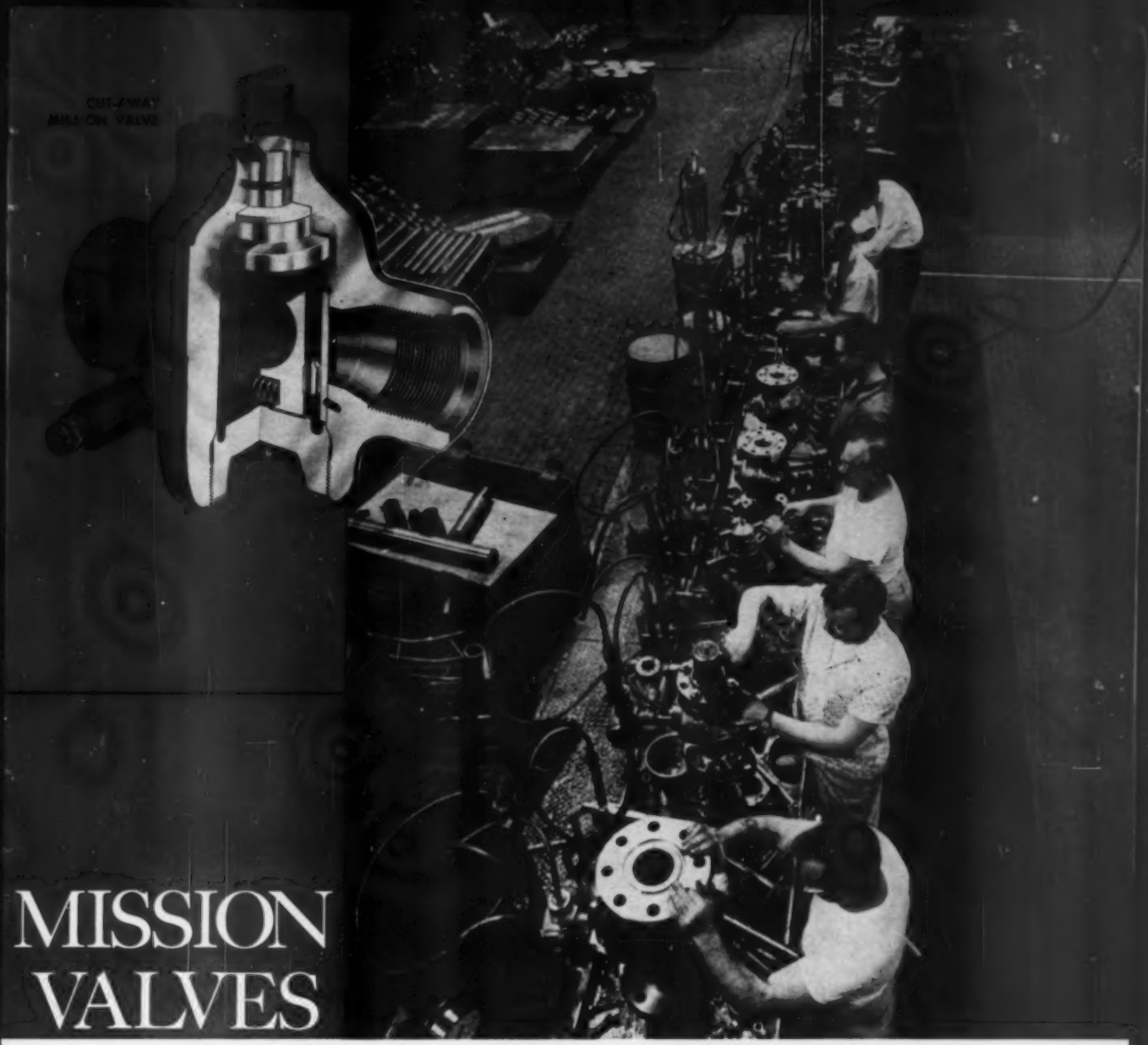
PITT CHEM Industrial Coatings are available through leading Industrial Distributors. See the "Yellow Pages."

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

WBW 7270

PROTECTIVE COATINGS • COAL CHEMICALS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON • FERROMANGANESE

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



MISSION VALVES

protect you with a seal that works for you

Line pressure actually seals Mission Valves more tightly. The greater the pressure against the closed valve, the more tightly Mission Sealant holds—acting like a plastic packing. This automatic sealant injection system literally stops leaks before they start. This basic design, constantly improved upon, has been proved by almost twenty years in the field. Backed up by the modern manufacturing techniques of Mission's new Houston plant, you know you're getting quality. These are the reasons Mission Valves do what they're supposed to do, and do it for years with very little maintenance. There are more than 315 different valves, bringing the positive advantages of the Mission Valve to practically every application. Specify Mission and eliminate your valve problems.

For over thirty years-quality built in to last

MISSION MANUFACTURING CO.

MISSION MANUFACTURING CO., P. O. BOX 4209, HOUSTON, TEXAS • CABLE ADDRESS—"MISSCO"
EXPORT OFFICE: 30 ROCKEFELLER PLAZA, NEW YORK • IN THE UNITED KINGDOM: MISSION MANUFACTURING CO., LTD., 17 HANOVER SQUARE, LONDON W. 1 ENGLAND • CABLE ADDRESS—"MISSOMAN"
PISTONS • PISTON RODS • SLIPS • GLAND PACKINGS • LINERS • LINER PACKING
PUMP VALVES AND SEATS • SWABS • VALVES • HAMMERDRILS • CENTRIFUGAL PUMPS

59-202

sary to know the friction loss of the fluid through the injection pipe and the perforations. Careful consideration of the friction loss may be of sizeable economic value to the operator. Friction loss in the pipe will expend horse power that should be delivered to the formation.

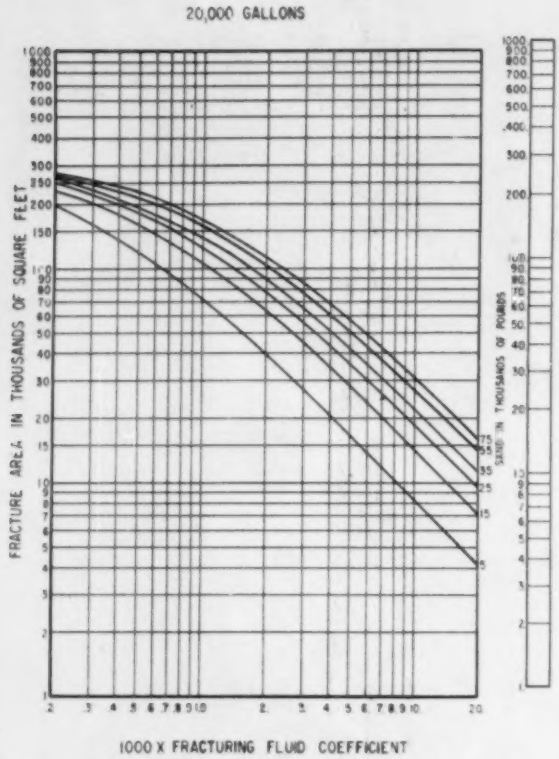

20,000 GALLONS
FRACTURE AREA IN THOUSANDS OF SQUARE FEET
SAND IN THOUSANDS OF POUNDS
1000 X FRACTURING FLUID COEFFICIENT

FIG. 3. **Fracture area curve**[7] used as an engineering tool in designing fracture treatments. Knowing the efficiency value of the fluid, other values may be varied to obtain desired results.

When treating through tubing, it is not unusual to use in excess of 80 percent of the total hydraulic horsepower to overcome friction losses.[6] Treating through casing may reduce this horsepower loss to a very low percentage. Methods for considering the complete fracture design have been published.[7]

Altering treatment. Crittendon[8] has presented a method for varying the treatment during its progress. The procedure is useful in that the plan can be readily modified at any time during the course of the treatment. The friction loss due to fluid flow through the perforations[9] is used to determine the number open and taking fluid.

It is difficult to determine just how much fracture area is needed to properly exploit a well. There are procedures outlined in the literature which give possible approaches. One such method was proposed by van Poolen, Tinsley and Saunders.[10] The method is limited due to the basic assumptions. It does present a means for calculating the theoretical production increase resulting from a given fracture. It is a very useful approach if enough is known about the reservoir.

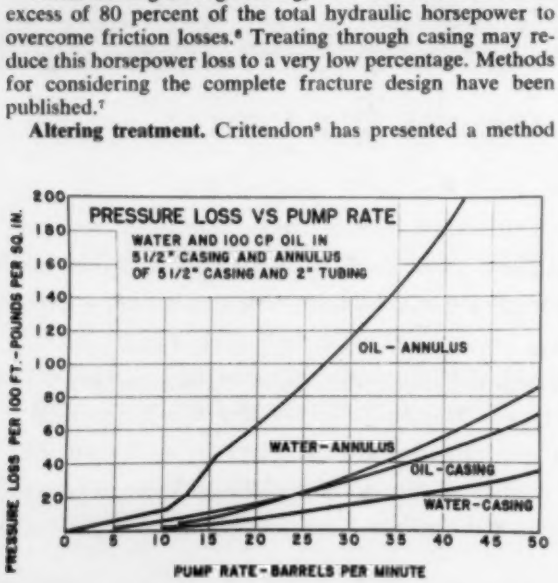

PRESSURE LOSS VS PUMP RATE
WATER AND 100 CP OIL IN
5 1/2" CASING AND ANNULUS
OF 5 1/2" CASING AND 2" TUBING
OIL - ANNULUS
WATER - ANNULUS
OIL - CASING
WATER - CASING
PRESSURE LOSS PER 100 FT. - POUNDS PER SQ. IN.
PUMP RATE - BARRELS PER MINUTE

FIG. 4. **Comparative friction loss**[3] of 100-centipoise oil and water.

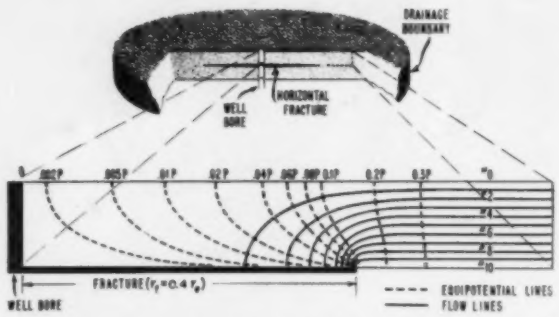


FIG. 5. **Assumed flow pattern** of reservoir fluids in formation which has been horizontally fractured. Radius of fracture is 0.4 of drainage radius. Dotted lines simulate equal pressure while solid lines represent paths of flow of produced liquids. (Taken from electrical model studies.[11])

PRE-PLANNING IMPORTANT

While some past fracturing treatments were adequate, most were not designed for maximum benefit. Since stimulation is vital to a majority of the wells drilled, provision should be made for the most desirable treatment during design of the well. The drilling, casing, mud and cementing, and perforating programs should be planned to fit the selected stimulation technique.

A sufficient amount of information is imperative in order to design the fracturing treatment. Much of these data must be obtained prior to completion of the well.

Acknowledgment

The authors wish to express their appreciation to the Halliburton Oil Well Cementing Company for permission to publish this paper.

References

1. Stekoll, Marion, "Fracturing Through Perforations." *Oil and Gas Journal*, October 29, 1956.
2. Coburn, R. W., "Engineered Completions Increase Oil Recovery." *World Oil*, October, 1958.
3. Ayres, Hugh J., and Saunders, Calvin D., "Production Stimulation—Planning and Operational Techniques." *Proceedings, West Texas Oil Lifting Short Course*, Texas Technological College, Lubbock, Texas, April 23 and 24, 1959.
4. van Poolen, H. K., "Damage Ratio Determined by Drill Stem Test Data." *World Oil*, November, 1957.
5. Howard, G. C., and Fast, C. R., "Optimum Fluid Characteristics for Fracture Extension." API, Paper No. 851-31-M.
6. Melton, Leonard L., "The Effects of Friction Loss in Tubular Goods On Horsepower Requirements During Fracturing." Prepared talk, local meeting, SPE of AIME, Tulsa, April 1, 1959.
7. "*A Method for Fracturing Treatment Design.*" Published by Halliburton Oil Well Cementing Company, April, 1959.
8. Crittendon, Bob C., "The Mechanics of Design and Interpretation of Hydraulic Fracture Treatments." SPE of AIME, Paper No. 1106-G.
9. Kraemer, Jack W., "Fluid Flow Rate Through Perforations." *The Petroleum Engineer*, January, 1959.
10. van Poolen, H. K., Tinsley, John M., Saunders, Calvin D., "Hydraulic Fracturing: Fracture Flow Capacity vs. Well Productivity." SPE of AIME, Paper Number 890-G.
11. van Poolen, H. K., "Productivity vs. Permeability Damage in Hydraulically Produced Fractures." API, Paper No. 906-2-G.

THE OIL STATES TUBING and DRILL PIPE SWAB

Design and performance features...

OIL STATES SWABS can be unloaded at any time above the fluid column; an important feature in sanding or overloading conditions.

OIL STATES CUPS, made of specially compounded rubber, last longer, with free side-to-side, up-and-down, and rotational movement.

THE ORIGINAL fluted mandrel on OIL STATES SWABS allows free-falling action.

OIL STATES CUPS give positive valving action; no ball and seat to wear; respond to wide range of load conditions.

Sold Through Supply Stores Only

THE OIL STATES TUBING AND DRILL PIPE SWAB

Patent No. 2,466,572 issued April 5, 1949
Patent No. 2,518,275 issued August 8, 1950
Patent No. 2,852,323 issued September 16, 1958
Patent No. 2,862,776 issued December 2, 1958

First marketed design field tested in 1954
First OIL STATES SWAB sold on February 15, 1955

Oil States

LOCATION OF OIL STATES FIELD REPRESENTATIVES:

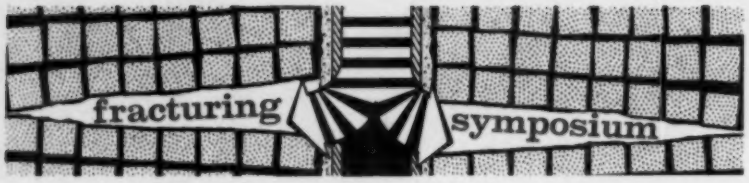
Alvarado, Texas	Borger, Texas	Corpus Christi, Texas	Houston, Texas
Kilgore, Texas	Odessa, Texas	Wichita Falls, Texas	Casper, Wyoming
Denver, Colorado	Farmington, New Mexico	Great Bend, Kansas	Oklahoma City, Oklahoma

In Canada: Edmonton, Alberta

West Coast Distributor: Monarch Engineering Co. Gardena, California

"OIL FIELD RUBBER PRODUCTS OF MATCHLESS QUALITY"

OIL STATES RUBBER COMPANY • ARLINGTON, TEXAS • CR 5-0441



A Practical Approach to . . . Choosing a FRACTURING FLUID

Choice of fracturing fluid can determine extent of formation fracture

V. C. White
Laboratory Manager
BJ Service, Inc.
Breckenridge, Texas

IT IS ASSUMED the reader is familiar with the method used by Howard and Fast[1] to determine the area of a fracture by calculations involving the variables of the fracturing treatment and of the well being fractured. This method has recently been the basis of several papers, all of which present simplified methods of handling the calculations and arriving at the answer — the fracture area resulting from a specified fracturing treatment of a well having specified characteristics. Considerable emphasis has been placed on the actual numerical answers that can be obtained by the method. But, much can be, and has been learned from the Howard and Fast method used. Probably the most important point is the procedure used to compare the effectiveness of different types of fracturing fluids.

As far as the fracturing fluid is concerned, the method mentioned above[1] deals only with the property of the fracturing fluid that extends, or fails to extend, the fracture — its tendency to leak out of the fracture and into the matrix of the formation.

The choice of fracturing fluid, in a sense, determines the extent of the formation fracture.

'Leak Off' Control

Howard and Fast consider separately three mechanisms that might control leak-off. The first of these is viscosity of the fracturing fluid. The second is the resistance to leak-off given by fluids in the formation, their compressibility and viscosity. The third is control of leak-off by use of a fracturing fluid that will build up a filter cake.

If every gallon of frac fluid pumped into a well during a treatment remained in the fracture and if the fracture width averaged .1 in. then the resulting fracture area would be 16 sq ft for each gallon of fracturing fluid. Calculated areas given hereafter will be presented as square feet per gallon of fracturing fluid so that a direct comparison may be made to the ideal of 16 sq ft per gal. Except where one property is varied as indicated all areas will be based on the following conditions:

Volume	10,000	gal
Injection rate	20	bbl per min
Permeability	15	millidarcies
Porosity	15	percent
Frac pressure differential	1000	psi
Fracture width	.1	in.

Frac Fluid Viscosity

The first type of leak-off control, viscosity of the fracturing fluid, is more or less effective depending on the formation properties of permeability, porosity and pressure differential while fracturing. This is illustrated in Table 1 which shows the calculated area resulting from treatments using a 200 centipoise viscosity fracturing fluid. 200 centipoises is about the maximum desirable viscosity of refined oils for use as fracturing fluid.

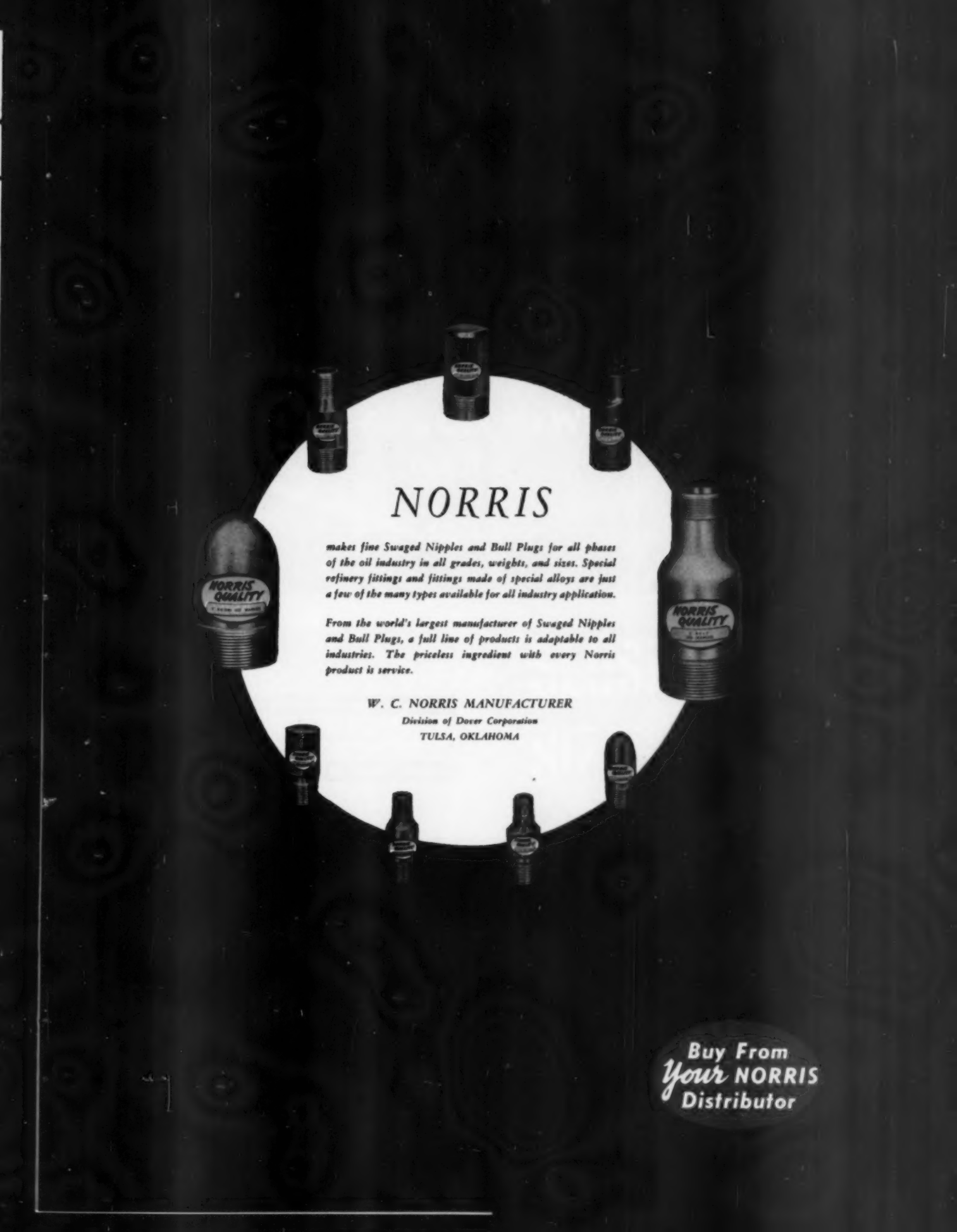
TABLE 1. Effect of Formation Properties on Fracture Area Resulting From Use of 200 Centipoise Frac Fluid.

Effect of Permeability		Effect of Porosity		Effect of Pressure Differential	
Permeability md	Fracture Area sq ft/gal	Porosity %	Fracture Area sq ft/gal	Press. Diff. psi	Fracture Area sq ft/gal
2	4.9	5	3.4	500	2.9
10	2.5	10	2.6	1000	2.1
30	1.6	15	2.1	1500	1.8
50	1.3	20	1.9	2000	1.6

From Table 1 it can be seen that each of the three variables (permeability, porosity and pressure differential), has a definite effect on the calculated area. And the higher the permeability and porosity of the well, and the higher the pressure differential during the treatment, the lower the resulting fracture area.

Formation Fluid Resistance

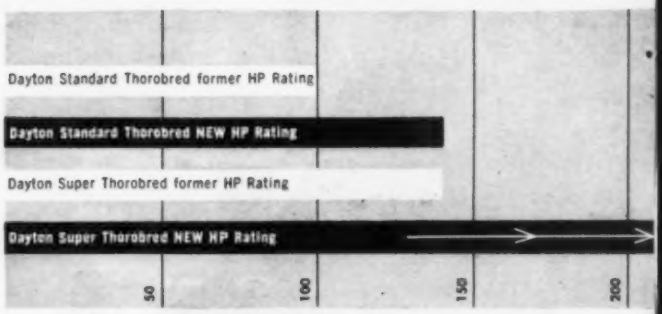
The second type of leak-off control, resistance to leak-off given by fluids in the formation, is also dependent for effectiveness on the formation properties listed above. Its effectiveness also depends on two other properties over which


NORRIS
makes fine Swaged Nipples and Bull Plugs for all phases of the oil industry in all grades, weights, and sizes. Special refinery fittings and fittings made of special alloys are just a few of the many types available for all industry application.
From the world's largest manufacturer of Swaged Nipples and Bull Plugs, a full line of products is adaptable to all industries. The priceless ingredient with every Norris product is service.
W. C. NORRIS MANUFACTURER
Division of Dover Corporation
TULSA, OKLAHOMA
NORRIS QUALITY
NORRIS QUALITY
Buy From Your NORRIS Distributor

New HP Ratings on Dayton Cog-Belts® provide important savings in Drive Space, Weight and Cost

Dayton Cog-Belt Horsepower Capacity increased to 200-300% of previous Standard Belt Ratings . . . using existing industry-standard sheaves

- Two Cog-Belts do the work of as many as 6 previous standard V-Belts.
- No special sheaves required . . . use existing sheave stocks on Cog-Belt drives.
- Job-proven Dayton quality is backed by the experience of many actual drive applications throughout industry.
- New ratings approved only after proven by most rigorous research standards.
- Your present sheave inventories cover a much greater range of horsepower capacities.
- Less belts per drive mean less drive space, less drive weight.



Thorobred and Super-Thorobred V-Belts also newly rated

- New Thorobred ratings are now 140% of previous standard belt ratings.
- New Super-Thorobred ratings are now 170-220% of previous standard belt ratings.

Write for new brochure showing how designers can calculate Dayton Cog-Belt drives by referring to existing drive selection tables in Dayton's #208-B Handbook of V-Belt Drive Design. See "Belting" in the yellow pages of your telephone directory for the name of your nearest Dayton Distributor, or write Dayton Industrial Products Company, Division of The Dayton Rubber Company, Dayton 1, Ohio.

Utilize over 30 years of time proven Dayton quality, research and engineering in your V-Belt drive design.

Dayton Industrial Products Co.

A Division of The Dayton Rubber Company, Dayton 1, Ohio

© D. R. Co. 1959

Designed with exact

WEIGHT-HORSEPOWER RATIO *for maximum performance*

Now there are seven different sizes of Continental-Emsco D-Series slush pumps . . one to match every rig requirement. They are an engineering milestone in combining the horsepower necessary for volume and pressure demands of modern drilling with a weight that makes transporting and handling around the rig site easy and economical . . even in remote oil fields of the world.

FABRIFORM CONSTRUCTION Gone are the bulky single iron castings. In their place are smooth, modern steel sheets and shapes welded together into a strong, rigid light weight frame.

HERRINGBONE GEARS Here again, weight is saved and compactness gained by design . . without sacrificing strength and power. Wide-faced, forged-steel, heat-treated herringbone gears provide quiet and efficient speed reduction. Forged, high-alloy steel pinion and pinion shaft are integral . . fully heat treated for maximum strength and resistance to wear.

ECCENTRIC ASSEMBLY Other features which add compactness to these pumps are: (1) use of a one-piece steel eccentric hub with gear mounting, eccentrics and main shaft integral; and (2) large diameter narrow eccentric roller bearings.

"EXPOSED" LINERS With this patented construction feature, packing leaks can be spotted immediately and stopped before fluid end is washed out. Liners cannot become "sanded-up" in the cylinder bore.

LUBRICATION Practically running in oil, all moving parts are flood lubricated by a positive splash lubrication system for less friction and longer operating life. Troublesome grease fittings and lubricators are eliminated.

NEW CONTINENTAL-EMSCO SLUSH PUMP SIZES

WITH

FIELD PROVEN DESIGN

Designed with exact

WEIGHT-HORSEPOWER RATIO *for maximum performance*

Now there are seven different sizes of Continental-Emsco D-Series slush pumps . . one to match every rig requirement. They are an engineering milestone in combining the horsepower necessary for volume and pressure demands of modern drilling with a weight that makes transporting and handling around the rig site easy and economical . . even in remote oil fields of the world.

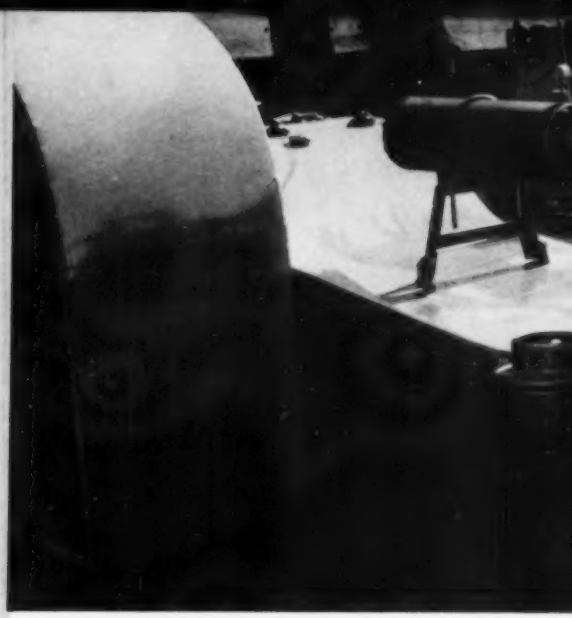
FABRIFORM CONSTRUCTION Gone are the bulky single iron castings. In their place are smooth, modern steel sheets and shapes welded together into a strong, rigid light weight frame.

HERRINGBONE GEARS Here again, weight is saved and compactness gained by design . . without sacrificing strength and power. Wide-faced, forged-steel, heat-treated herringbone gears provide quiet and efficient speed reduction. Forged, high-alloy steel pinion and pinion shaft are integral . . fully heat treated for maximum strength and resistance to wear.

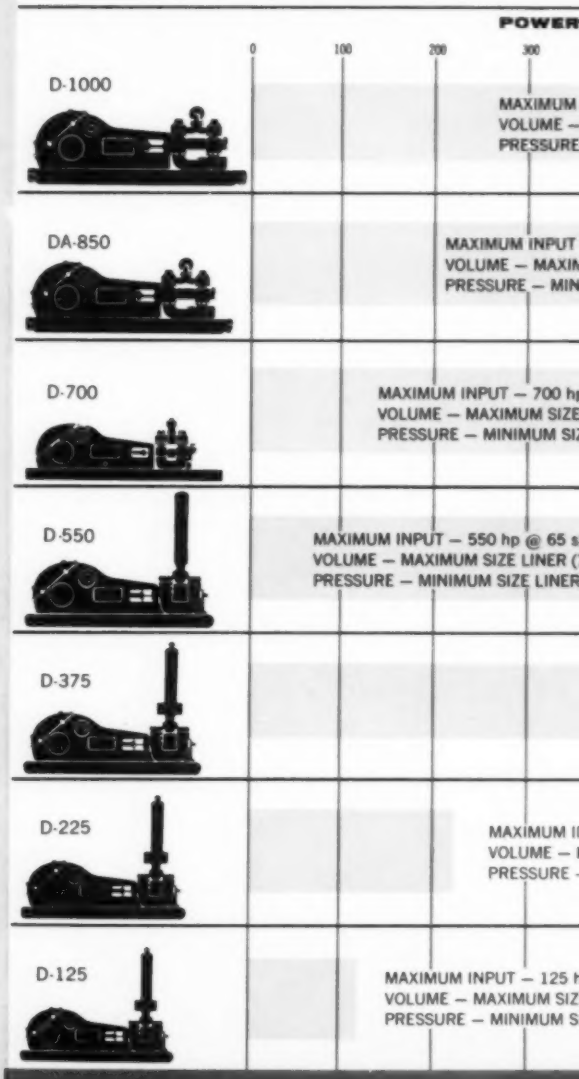
ECCENTRIC ASSEMBLY Other features which add compactness to these pumps are: (1) use of a one-piece steel eccentric hub with gear mounting, eccentrics and main shaft integral; and (2) large diameter narrow eccentric roller bearings.

"EXPOSED" LINERS With this patented construction feature, packing leaks can be spotted immediately and stopped before fluid end is washed out. Liners cannot become "sanded-up" in the cylinder bore.

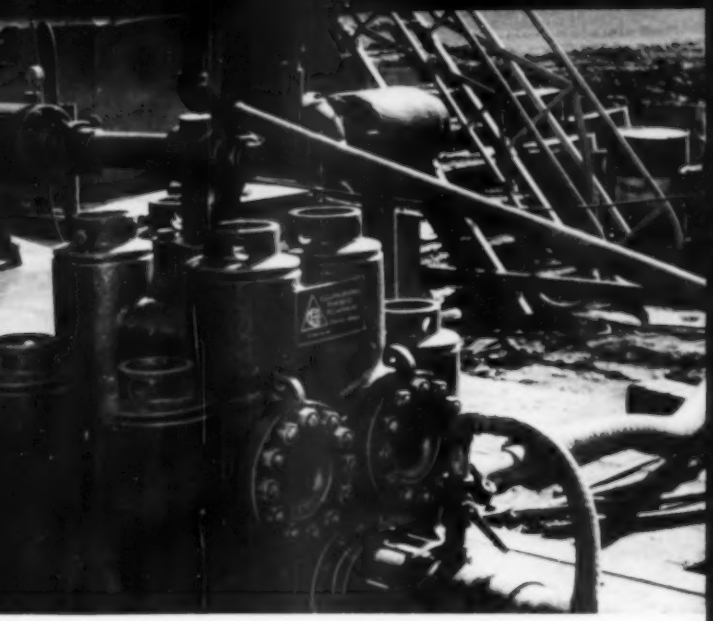
LUBRICATION Practically running in oil, all moving parts are flood lubricated by a positive splash lubrication system for less friction and longer operating life. Troublesome grease fittings and lubricators are eliminated.



POWER, PRESSURE, VOLUME



For Service that Sings . . Equipment



ME FOR EVERY RIG REQUIREMENT..

WER INPUT RATING (HORSEPOWER)

0 400 500 600 700 800 900 1000

IMUM INPUT – 1000 hp @ 60 spm
UME – MAXIMUM SIZE LINER (8¼") – 933 gpm
SSURE – MINIMUM SIZE LINER (5¾") – 3,480 psi

NPUT – 850 hp @ 60 spm
MAXIMUM SIZE LINER (8¼") 933 gpm
– MINIMUM SIZE LINER (5¾") 2,954 psi

700 hp @ 65 spm
M SIZE LINER (8¼") 909 gpm
UM SIZE LINER (5½") 2,727 psi

@ 65 spm
INER (7½") 751 gpm
LINER (4¾") 2,915 psi

MAXIMUM INPUT – 375 hp @ 70 spm
VOLUME – MAXIMUM SIZE LINER (7½") 723 gpm
PRESSURE – MINIMUM SIZE LINER (4¾") 1,991 psi

MUM INPUT – 225 hp @ 70 spm
ME – MAXIMUM SIZE LINER (7¼") 580 gpm
SURE – MINIMUM SIZE LINER (4½") 1,551 psi

125 hp @ 85 spm
UM SIZE LINER (7¼") 590 gpm
MUM SIZE LINER (4½") 840 psi

nt that Hums.. Go ***CONTINENTAL-EMSCO!***

CECO.

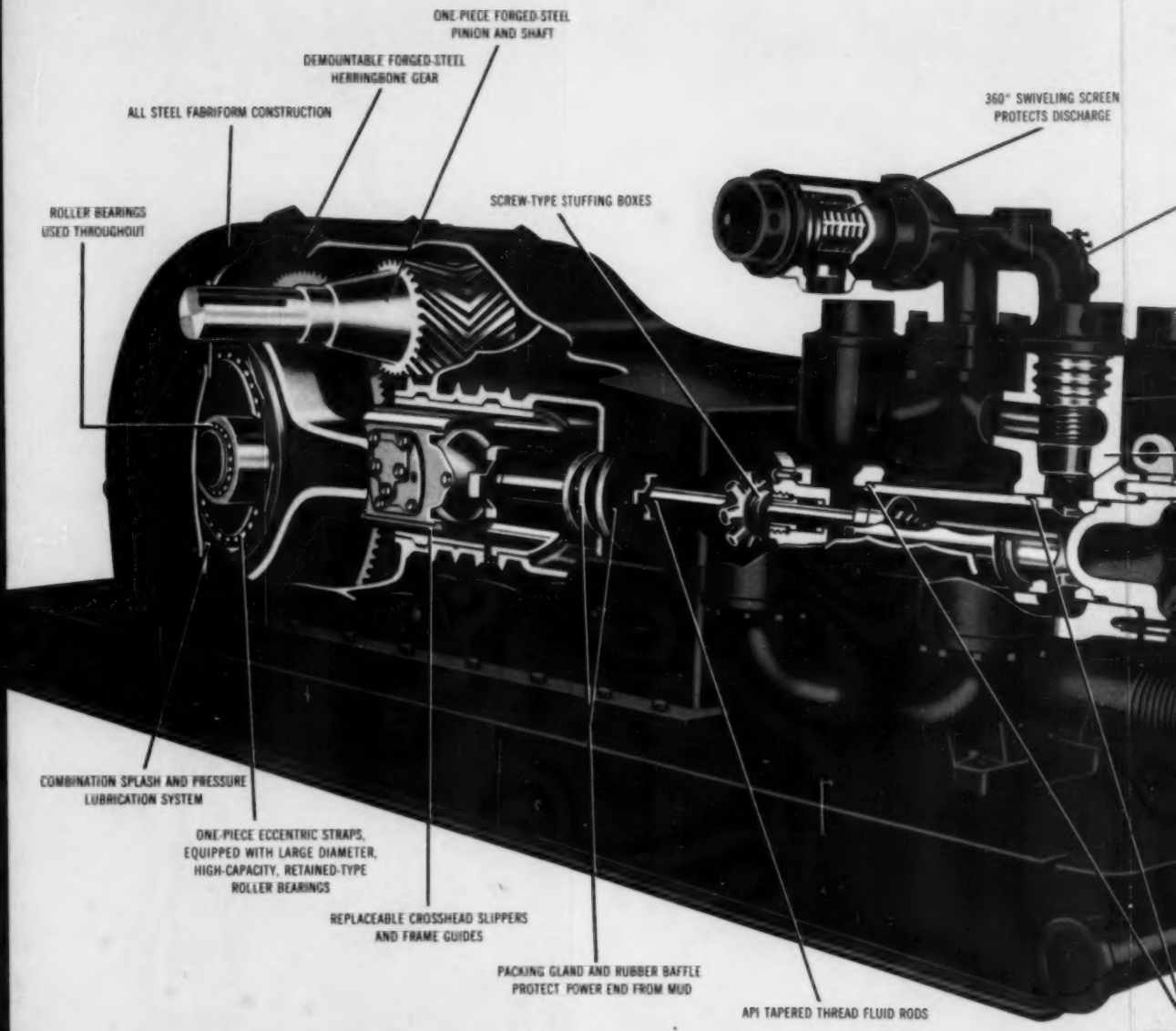
NEW CONTINENTAL-EMSCO SLUSH PUMP SIZES

WITH

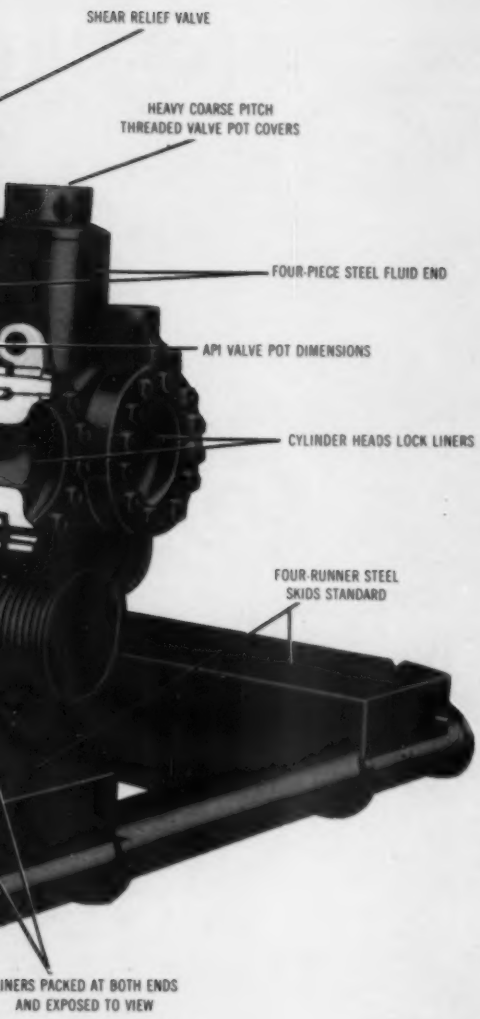
FIELD PROVEN DESIGN

Now a Complete Line . . . with FIELD P

CONTINENTAL-EMSCO SLU


ONE-PIECE FORGED-STEEL PINION AND SHAFT
DEMOUNTABLE FORGED-STEEL HERRINGBONE GEAR
ALL STEEL FABRIFORM CONSTRUCTION
360° SWIVELING SCREEN PROTECTS DISCHARGE
ROLLER BEARINGS USED THROUGHOUT
SCREW-TYPE STUFFING BOXES
COMBINATION SPLASH AND PRESSURE LUBRICATION SYSTEM
ONE-PIECE ECCENTRIC STRAPS, EQUIPPED WITH LARGE DIAMETER, HIGH-CAPACITY, RETAINED-TYPE ROLLER BEARINGS
REPLACEABLE CROSSHEAD SLIPPERS AND FRAME GUIDES
PACKING GLAND AND RUBBER BAFFLE PROTECT POWER END FROM MUD
API TAPERED THREAD FLUID RODS
LINERS
AND

PROVEN DESIGN
USH PUMPS



POWER END FRAME

Fabriform construction of power end frame is unique in that it: (1) allows metal to be placed exactly where it is needed to reinforce critical stress areas and to form a strong, light weight frame; (2) permits the use of thin steel plates and shapes in place of bulky, heavy iron castings. Precision machining of the power end frame assures accurate alignment of main shaft, pinion shaft and crosshead bores. All machining operations take place after the power end frame has been completely stress relieved.

FLUID END

Maximum strength is built into this critical part by the use of steel castings, electrically welded into a single unit. Each valve is located in a separate pot or valve chamber for easy access. Threaded valve pot covers are designed to reduce bulk and weight and to speed up valve inspection and replacement. Suction passages are large, direct and smoothly curved to prevent restriction of fluid flow . . even when heavy drilling muds are used. Use of one suction eliminates *dead spaces* which tend to break up a streamline flow.

MANUFACTURED BY

CONTINENTAL-EMSCO

Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL-EMSCO COMPANY • A Division of The Youngstown Sheet and Tube Company
General Offices: Dallas, Texas • Plants: Houston and Garland, Texas

Distributed by
BOVAIRD SUPPLY COMPANY
TULSA, OKLAHOMA

MID-CONTINENT SUPPLY COMPANY
FORT WORTH, TEXAS
Export: Mid-Continent Supply Co., Inc., 45 Rockefeller Plaza, New York 20, N.Y.

In California
CONTINENTAL-EMSCO COMPANY

Litho in U.S.A. JSP 920

no control is possible — viscosity and compressibility of reservoir fluids.

The compressibility, especially, has a great deal of effect on the amount of leak-off and if there is any free gas present in the reservoir the compressibility becomes so high there is very little resistance given to leak-off of the fracturing fluid.

Table 2 shows the effect of formation characteristics on the calculated area resulting from fracturing with crude oil as the fracturing fluid. A formation fluid compressibility coefficient of 1×10^{-5} and a formation fluid viscosity of 4 centipoises are assumed for this comparison.

TABLE 2. Effect of Formation Properties on Fracture Area Resulting From Use of Crude Oil Frac Fluid.

Effect of Permeability		Effect of Porosity		Effect of Pressure Differential	
Permeability md	Fracture Area sq ft/gal	Porosity %	Fracture Area sq ft/gal	Press. Diff. psi	Fracture Area sq ft/gal
2	7.2	5	5.3	500	5.8
10	4.1	10	4.1	1000	3.5
30	2.6	15	3.5	1500	2.5
50	2.1	20	3.1	2000	1.9

Table 2 shows that the three variables have a great effect on the calculated area when control of leak-off is left up to reservoir fluid conditions. It should also be emphasized that probably very few wells would have low compressibility and no free gas, the conditions necessary for the areas to be as large as those shown in Table 2.

Formation Variables

It has been shown that the effectiveness of two of the three available types of fracturing fluids depends on the characteristics of the formation being fractured.

Since formation characteristics must be used in calculating fracture extent the best information available should be used — even though "the best available" frequently leaves a lot to be desired.

Properties measured by core analysis, when averaged as is necessary for use in calculating fracture areas, may be representative of the formation at the place where it is penetrated by the well bore but the averages might be quite different back in the formation away from the well bore.

A glance at nearly any electrical log will show that productive formations are usually not homogeneous. Permeability can vary many-fold from a horizontal to a vertical direction and a fracture might be at any angle between the two.

In any case the effect of formation characteristics on fracture extent when a viscous fracturing fluid is used or when crude oil or water is used as the fracturing fluid is a major one and there is no control over the formation characteristics. It would seem more logical to use a fracturing fluid that would be at least less dependent on formation characteristics. This is possible by using the third type of fracturing fluid, one having a low fluid loss because of its wall building property.

Theoretically (and in actual practice to a large extent as shown by laboratory test), the leak-off through a filter cake depends on the filter cake itself rather than on the porosity and permeability of the material over which the filter cake is deposited. Also, if the material composing the filter cake (the fluid loss additive used in the frac fluid) is designed for the higher pressures to be expected in fracturing, the different pressure differentials encountered have only little effect on leak-off.

Probably the most important point about the low fluid loss type of fracturing fluid is that the amount of leak-off depends almost entirely on the fracturing fluid itself rather than on the combined properties of the fracturing fluid and the formation.

Steps can be taken in formulating the fluid loss additive so that the fracturing fluid is equally effective in extending the fracture regardless of formation conditions.

Calculating Fluid Loss

The most widely used method of measuring the fluid loss property of a fracturing fluid at the present time is by use of a high-temperature, high-pressure filter press. The test uses a filter paper as the filter medium and 1000 psi as the pressure differential.

Temperature can have a very large effect on this test but if the additive performs satisfactorily at 80 deg F, which is close to the lowest temperature that might be expected, and at 200 deg F, which is in the range of the expected higher temperatures, it could be considered effective at any bottomhole temperature.

Low Cost Additives

Suitable fluid loss additives are available for oil, water and acid, the three base liquids used as fracturing fluids. The 30-minute fluid losses shown in Table 3 can be easily attained with fluid loss additives now available. This low fluid loss can usually be had at a cost for the additive of 5 cents, or less, per gallon of fracturing fluid.

TABLE 3. Effect of Fluid Loss of the Fracturing Fluid on Fracture Area.

Fluid Loss cc's in 30 min	Spurt Loss cc's	Fracture Area sq ft/gal
10	0	6.7
10	1	6.7
10	5	9.5
15	0	5.1
15	1	4.9
15	5	5.1
15	10	9.3
20	0	4.1
20	1	4.0
20	5	3.8
20	10	4.9

Since fracture extension by use of a low fluid loss fracturing fluid does not vary appreciably with the formation characteristics of permeability, porosity and pressure differential, the fracture areas shown in Table 3 can be assumed to apply to practically all formations. The treatment variables of volume of fracturing fluid, injection rate and fracture width are the same in Table 3 as those used in Tables 1 and 2.

A comparison of the fracture areas in Table 3 with those in Tables 1 and 2 will show that the low fluid loss fracturing fluid nearly always results in larger fracture areas than the viscous type or the high fluid loss, low viscosity type fracturing fluids for the conditions stated.

The efficiency of a fracture treatment depends on the amount of leak-off of the fracturing fluid from the fracture to the matrix during the treatment.

The leak-off of viscous type fracturing fluids and of low viscosity, high fluid loss type fracturing fluids depends to a great extent on formation conditions which are not subject to control. Fracturing fluids which have been given a low fluid loss by means of fluid loss additives are much less dependent on formation conditions and their use will usually result in better and more dependable fracturing efficiency.

References

1. Howard, G. C. and Fast, C. R.: "Optimum Fluid Characteristics For Fracture Extension." API Drilling and Production Practice, 1957, page 261.

It couldn't be done without the RUBBER SLEEVE Core Barrel

Complete core recovery, even in soft, unconsolidated or fractured formations

Just over a year ago, Christensen Diamond Products Company introduced an entirely new concept in core packaging to the oil industry . . . the Rubber Sleeve Core Barrel.

Since that time, many formations that were formerly difficult or impossible to core, have been cored successfully with the rubber sleeve core barrel.

This rubber sleeve barrel actually encases the core in a protective rubber package, which reduces contamination to a minimum and eliminates many of the bridging, crumbling and jamming problems encountered with conventional barrels.

The rubber-packaged cores are ideal for handling and shipping and can be easily stored without altering the physical or fluid content, thus eliminating the need for freezing or canning of cores.

And now, laboratories have developed techniques which enable them to obtain accurate reservoir information without removing the core from the rubber sleeve, even with softest formations.

If your problem is poor core recovery, call Christensen, and learn how you can get "good" cores at "Less Cost Per Foot."

Diamonds Mean, "Less cost per foot."

CHRISTENSEN DIAMOND PRODUCTS

1937 SOUTH SECOND WEST • SALT LAKE CITY, UTAH

For more detailed information and case histories on the Rubber Sleeve Core Barrel, or any of Christensen's complete line of conventional and wireline core barrels, write or call Christensen Diamond Products Company.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

459.7

fracturing symposium

Evaluation and Selection of Fracture PROPPING AGENTS

In certain formations, sand used as a fracture propping agent tends to be crushed or to be embedded in the fracture faces. Certain organic particles, notably crushed walnut shells, are being used successfully as propping agents in such formations

J. L. Huitt and B. B. McGlothlin
Gulf Research & Development Company
Pittsburgh, Pennsylvania
and
J. F. McDonald
Gulf Oil Corporation
Oklahoma City, Oklahoma

ONE OF THE PREDOMINANT FACTORS controlling the success of a hydraulic-fracturing operation is the propping of the fracture. By and large, sand has been the universal fracture-propping agent for all formations, with only the size and concentration being changed in an attempt to improve the results of fracturing. For fracturing in some formations, these changes alone have been sufficient. However, in other formations it has become evident that other propping agents would produce better results. The purpose of this article is to discuss the conditions under which sand is not a suitable propping agent and to present data on other materials that may be used.

RELATED STUDIES AND THEORY

As the overburden load supported by a grain of propping sand in the fracture becomes excessive, the sand grain will either embed in the formation or crush. In the study of Dehlinger, et al,[1] it was assumed that the load-carrying capacity, L, of a spherical grain of propping sand was a function of the compressive strength of the formation, S_c, and the contact area, a, between the grain and the formation. This may be expressed as:

$$L = aS_c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

In this cited study for a given size and concentration of propping sand, it was shown that as the overburden pressure was increased, the fracture capacity became less. This condition resulted from a smaller fracture width which, in turn, resulted from the embedment of the propping sand in the formation. Whereas the embedment condition is the controlling factor in a number of formations, there are formations in which embedment is resisted to the extent that the propping sand is crushed.

In a more recent study[2] it was shown that the propping sand could crush or embed, depending upon the formation. The approach to embedment in this study was analogous to a penetration-hardness test of metal, and a quantitative method was given by which the extent of embedment could be determined. The method was based on the relation that the ratio of the diameter of the impression, d, made by a grain of propping sand in the formation to the grain diameter, D, is a function of the ratio of the load, L, on the sand grain to the square of the sand-grain diameter. This was expressed as:

$$\frac{d}{D} = B^{1/2}\left(\frac{L}{D^2}\right)^{m/2} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

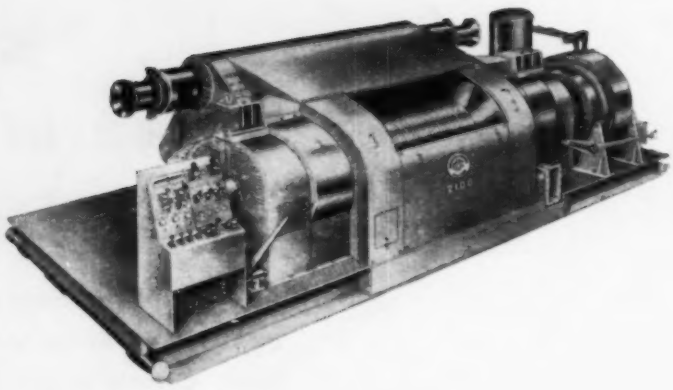
where B and m are characteristic constants for a particular formation. However, as in the study of Dehlinger, et al,[1] the propping of the fracture was based on the partial embedment of the propping sand in the formation. The lack of embedment which could result in the crushing of the propping sand was only mentioned qualitatively. Thus, although these previously cited studies have been useful in a better understanding of fracture propping, neither was concerned with the crushing of the propping sand.

For formations of sufficient hardness to permit only a very small embedment of the propping agent, the grains of the propping agent are essentially point-loaded by the overburden load. By this condition, the total load that a single particle of the propping agent supports is concentrated on a very small portion of the surface area of the particle. This is exemplified in Fig. 1. If this condition is idealized by considering the propping-sand grains to be elastic spheres and the fracture surfaces to be thick elastic plates that are forced together by a force acting through the points of contact and perpendicular to the plates, the problem is reduced

Based on paper entitled "The Propping of Fractures in Formations in which Propping Sand Crushes" presented at Spring Meeting of the Rocky Mountain District, Division of Production, American Petroleum Institute, at Casper, Wyoming, May 6-8, 1959.

USE GARDNER-

- Drawworks
- Mud pumps
- Air drilling compressors
- Well servicing pumps
- Rig air compressors
- Air hoists
- Impact wrenches



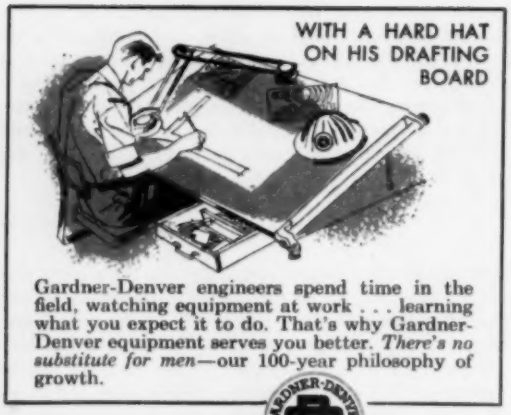
GD-2100 hp Drawworks

Gardner-Denver engineered for the deepest drilling today and tomorrow. More than 130,000-lb. single line pull. Moved in one load.

Only Gardner-Denver builds all these quality items for your rig

They're engineered for mobility, rugged dependability and simplified maintenance on location . . . designed by men who know your field requirements from firsthand experience . . . built to help you cut costs and drill faster.

Gardner-Denver oil field specialists on call in strategically located cities at all major oil field areas. Parts stocked in supply stores and Gardner-Denver warehouses throughout the oil world.



Gardner-Denver engineers spend time in the field, watching equipment at work . . . learning what you expect it to do. That's why Gardner-Denver equipment serves you better. *There's no substitute for men*—our 100-year philosophy of growth.

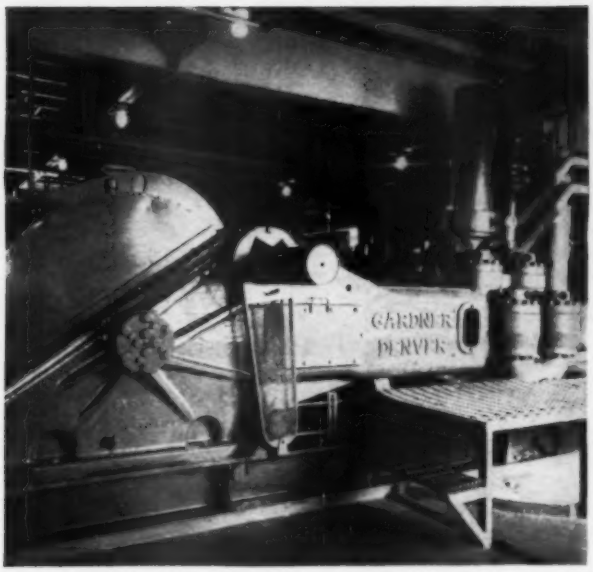
EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario
Gardner-Denver Export Division, 233 Broadway, New York 7, N. Y.
Oil Field Offices: Casper, Cleveland, Columbus, Corpus Christi, Dallas, Denver, Durango, Edmonton, Ellinwood, Evansville, Houston, Huntington, Jackson, Kansas City, Lafayette, Los Angeles, Mexico City, New Orleans, Odessa, Oklahoma City, Pittsburgh, San Francisco, Shreveport, St. Louis, Tulsa, Wichita, Winnipeg

DENVER QUALITY ON YOUR RIG

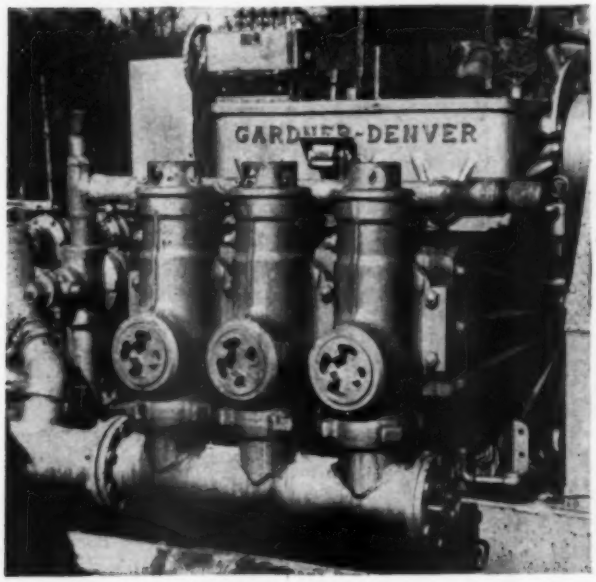


Gardner-Denver Mud Pumps

Famous Gardner-Denver eccentric construction. Divided fluid end cylinders. Models to 1250 hp to meet capacity and pressure needs of every rig.

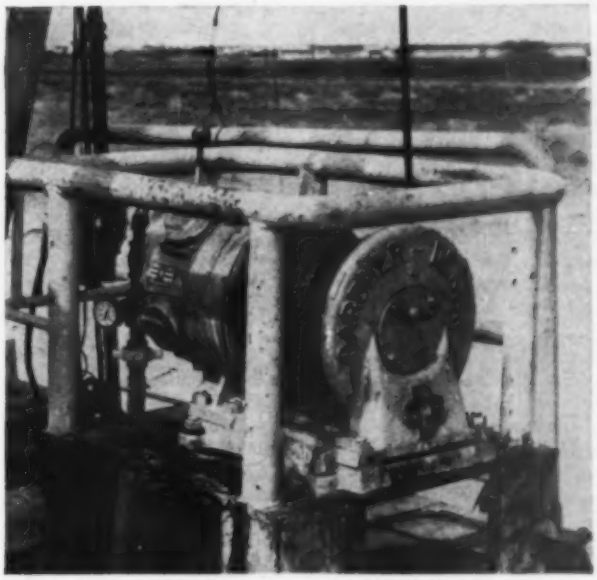
Air Drilling Compressors

Packaged units completely engineered by Gardner-Denver. Cooling system designed for continuous service. Field-proved for air or gas drilling, mud aeration.



Well Servicing Pumps

Triplex and six-cylinder plunger pumps for cementing, acidizing, fracturing or work-over. Provide squeeze pressures to 10,000 psi.



Compressed Air Power

Gardner-Denver air hoists handle snaking and lifting jobs. Impact wrenches and air tools speed maintenance, rigging up and tearing down.

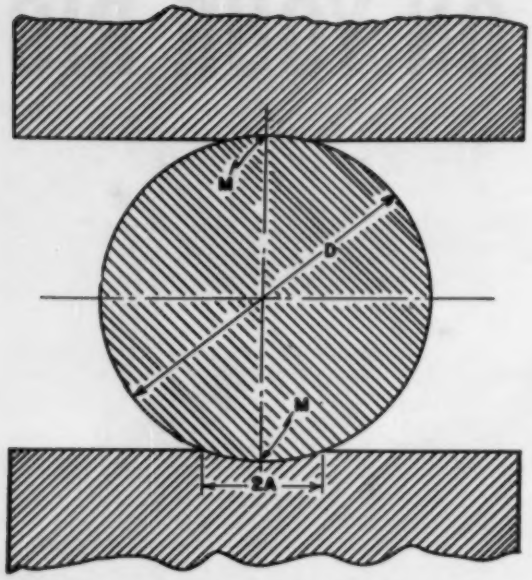


FIG. 1. **Point loading of a sphere** between parallel plates approximates the forces tending to crush or embed sand grains used as fracture propping agents.

to one of Hertzian [3] loading. In turn, if this Hertzian loading is treated in the manner as described in Timoshenko,[4] it can be shown that for an elastic spherical and planar body, the ratio of the load at failure to the square of the diameter of the sphere will be constant. This can be expressed as:

$$\frac{L_{crit}}{D^2} = C \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

In terms of fracture propping with sand in formations of sufficient hardness to permit only a very small embedment, Equation 3 simply means that the propping sand will crush as the L/D^2 ratio approaches C. In most cases the value of C cannot be calculated directly as all the necessary properties of the formation rock and propping-sand grains are not known. However, C can be determined experimentally as discussed later.

It was readily seen in the early stages of this study that it was not feasible to use sand as a propping agent in some formations where high fracture capacities were needed. Thus, other propping agents which could withstand the overburden loads were desirable.

The alternate method of selecting a suitable propping agent was to obtain one which reacted differently than sand to loading. That is, even though the critical load was surpassed, the particle would essentially remain in "one piece" and possess sufficient resistance to additional crushing so that a high fracture capacity could be maintained. One manner in which this was obtained was the use of a coating material to form an envelope for the propping sand. The other approach was the use of organic type of materials which tend to "pancake" until sufficient bearing surface is available to support the imposed load.

EXPERIMENTAL METHODS

Critical Loading of Propping Sand

By the point loading theory, Equation 3 predicts that the grains will be crushed when the L/D^2 ratio exceeds a given value which is constant for a particular propping-sand formation combination. For the tests to determine the critical values for the various propping-sand formation combinations, core samples were selected in which the sand would crush rather than embed.

In the point-loading test three sand grains were placed on the circumference of a 2½-in. diameter circle at 120-deg spacing on a flat diamond-sawed core sample. Sand grains for the test were selected from a 10-20 mesh fraction of Ottawa sand. The grains selected for a single test were essentially the same size and nearly round. Three perpendicular "diameters" were measured to the nearest 0.002 in. with an optical comparator. The arithmetic average of the three "diameters" was used as the grain diameter. A similar core-sample disc was placed on top of the sand grains and a load was applied which acted through the center of the described circle. The load was increased in small increments until one or more of the sand grains crushed. At this point one-third of that load resulting in crushing was taken as the critical load. This procedure was repeated on the same core sample with different sizes and samples of the propping sand. Also, core samples of other formations (possessing the similar property of crushing the propping sand) were used.

Flow Studies

Metal plates were used to simulate the fracture surfaces in the flow studies with the various propping agents. By penetration tests [2] it was found that a brass stock offered approximately the same resistance to embedment of the propping sand as did a typical formation in which the propping sand was crushed. The brass plates were roughened to simulate a fracture surface by repeated crushing of sand grains between them. The other components comprising the flow cell used in the flow studies are shown in Fig. 2.

The fracture capacities obtained with various sizes, concentrations, and types of propping agents were determined from fluid-flow data obtained with the flow cell under simulated overburden pressures. The selected concentration of the propping agent was placed on the lower "fracture surface." The cell was partially assembled and placed in the hydraulic press where the simulated overburden pressure was applied. The fracture width was measured by means of a cathetometer and/or feeler gage, and then the cell assembly was completed for the flow study. The fluids used were water and Soltrol-C. The pressure differentials across the test section of the flow cell were measured with an inclined manometer.

The concentration of a propping agent for any particular

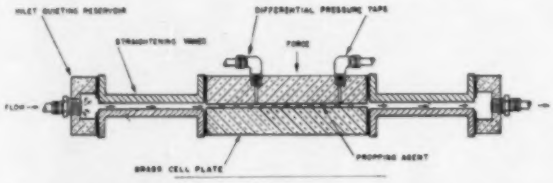


FIG. 2. **Permeability flow cell** used to determine the flow capacities through formations propped with various propping agents.

flow-study test was based upon the weight of the propping agent and the void volume of the flow-cell fracture section under no load, and was expressed in pounds per gallon. For the sand-propped fracture the concentration varied from a partial monolayer to a multilayer sand pack (1 to >33 lb per gal). For the coated sand and organic materials only partial monolayers were used (0.5 to 2.0 lb per gal for the coated sand; 0.1 to 1.5 lb per gal for the organic materials).

Most of the flow tests were made at 3000 and 4300 psi overburden pressures. However, for the tests with rounded walnut-shell particles, the overburden pressure was varied from 3000 to 7000 psi. Also, some of the tests with the

Only Known Motor Specifically Designed for Oil Well Pumping
HIGHEST MOTOR SLIP lets counterweight inertia absorb the shock of the rig's sudden peak loads—not the motor!
HIGHEST STARTING TORQUE provides the extra power needed to always start the rig. Stalling is now eliminated!

NEW GENERAL ELECTRIC TYPE KOF MOTOR NOW MAKES POSSIBLE . . .

Lowest Oil Well Pumping Cost Per Barrel; Dependable, Unattended Rig Starting

General Electric's new Type KOF motor is the only known motor designed specifically to handle the unusual load demands of oil well pumping rigs!

Eight- to ten-percent slip—highest of any oil well pumping motor—lets the rig's inertia smooth out load and current peaks that often damage ordinary motors and cause voltage fluctuations. This means lowest kw-hr cost per barrel pumped!

Four-hundred-percent (400%) starting torque gives General Electric's new Type KOF the extra power needed for dependable starting on unattended rigs. Highest starting torque prevents stalling and costly motor burnout!

No other motor has been designed so completely around the requirements of the oil well pumping application. For the full story call your authorized motor distributor or nearby Apparatus Sales Office; or write direct to Section 899-4, General Electric Co., Schenectady 5, N. Y.

Compare General Electric's New Type KOF Motor

	Starting Torque	Motor Slip	Double-end Ventilation	762-volt Connection	Regreasable Design
General Electric (Beam-type Pumping Motor)	High	8-10%	Yes	Yes	Yes
Manufacturer "A" (NEMA C)	Low	2-3%	No	No	No
Manufacturer "B" (NEMA D)	Med.	5-8%	Yes	No	Yes
Manufacturer "C" (NEMA D)	Med.	5-8%	No	No	No

Progress Is Our Most Important Product

GENERAL ELECTRIC

FIG. 3. **Reaction of propping agents to loading** illustrates the effect of crushing forces on sand grains, coated sand grains, and organic particles, such as crushed walnut shells.

walnut shells were of 3-day duration, whereas the tests with the other materials lasted 4 hours or less.

The materials used in the tests in which coated sand grains were used as the propping agent were asphalt, rubber latex, and an acrylic plastic. The thickness of the coating placed on all grains was in the range of 0.005 to 0.01 in.

Some of the organic materials used as propping agents are listed in Table 4. Some of these materials were used in their natural state, whereas it was necessary to crush and screen other materials to obtain the desired mesh size. The walnut shell was a crushed material which had been specially "rounded" for these tests.

DISCUSSION

Considerable data were obtained during this study; however, only those considered necessary to illustrate certain points are included. Qualitatively, the results obtained when the various types of propping agents were subjected to the overburden load are illustrated by Fig. 3.

Point Loading of Propping Sand

The results of a typical point-loading test between a given propping sand-formation combination are given in Table 1. This combination is Ottawa propping sand and the Skinner sand formation (about 5000 ft depth in Noble County, Oklahoma). The values for the $\frac{L_{crit}}{D^2}$ ratio obtained for the various sand grains are in good agreement, when the nature of such a test is considered. The average value is about 10,000 and is fairly representative of the $\frac{L_{crit}}{D^2}$ ratio for this type of propping sand and a formation in which the embedment is very small.

There are several ways in which the $\frac{L_{crit}}{D^2}$ ratio may be applied in fracture propping. One way is exemplified by considering a fracture in the previously cited formation to be propped with a 10-20 mesh Ottawa sand. The grains in a 10-20 mesh sand fraction will range in diameter from 0.0331 to 0.0787 in. (openings in the 20 and 10-mesh screens of the U.S. Sieve Series, respectively). On three samples of Ottawa sand tested, the grains ranged from 430 to 525 per sq in. for a close-packed monolayer with an average number of 480 grains per sq in. As the overburden comes to rest on the propping sand, the largest grains would be point loaded first.

For example, consider those grains 0.078 in. in diameter. The critical load for this size grain — by Equation 3 — would be about 60 lb. To prevent crushing under a 5000 psi overburden pressure, there would have to be 84 of the 0.078-in. diameter grains per sq in., which is about 17 percent of the sample. It is practically impossible to get this percentage of the grains the same size; thus, the 0.078-in. diameter grains in the fracture would be crushed.

The crushing of the largest grains in a particular mesh size of propping sand does not mean the smaller grains will necessarily be crushed. However, under point loading the larger grains (remaining) will continue to crush until the load per grain (loaded) is less than the critical load for that particular size particle. It is difficult to visualize a propping sand of such uniform grain size as to prevent crushing under point loading. Thus, it is believed that crushing of the sand will continue until the sand is crushed to the extent that point loading will no longer apply.

The discussion thus far has pertained to the monolayer pack. Obviously the same approach would apply to concentrations in the fracture that are less than a monolayer. In the case of multilayers, the point-loading theory (as defined in this study) cannot be applied. However, as will be shown later, crushing still occurs with multilayer packs in formations where the embedment is very small.

TABLE 1. Crushing of Sand Under Point Loading.*

L_{crit}, lb	D, in.	$\frac{L_{crit}}{D^2}$, lb per sq in.
15.8	0.035	11,600
20.6	0.045	10,000
21.6	0.045	10,600
18.3	0.045	9,000
22.5	0.045	11,100
23.4	0.050	9,400
31.6	0.055	10,400
23.3	0.055	7,700
30.0	0.055	9,900
	Average	10,000

*10-20 mesh Ottawa sand crushed against core samples of the Skinner sand formation obtained from depth of about 5000 ft in Noble County, Oklahoma.

TABLE 2. Sand-Propped Fractures.

Propping Sand*			Propped Fracture		
Mesh Size (U. S. Sieve Series)					
Screen No.	Openings (mm)	Concentration** (lb per gal)	Overburden Pressure (psi)	Fracture Width (mm)	Capacity (md-ft)
20-40	0.84-0.42	2	3,000	***	<10
		4	3,000	***	10-30
		4	4,300	***	<10-20
		monolayer	3,000	0.50-0.60	30-50
		monolayer	4,300	0.45-0.55	10-20
		3-layer pack	3,000	1.5 -1.8	200-300
		3-layer pack	4,300	1.4 -1.7	150-250
10-20	2.00-0.84	2	3,000	***	<10
		4	3,000	0.25-0.40	50-100
		4	4,300	0.20-0.30	30-60
		monolayer	3,000	1.0 -1.4	80-150
		monolayer	4,300	0.80-1.2	50-100
		3-layer pack	3,000	2.4 -2.8	600-1000
		3-layer pack	4,300	2.2 -2.5	400-800
6-10	3.36-2.00	2	3,000	0.40-0.70	10-40
		4	3,000	0.60-1.0	30-80
		4	4,300	0.50-0.90	20-60
		monolayer	3,000	2.2 -2.8	50-100
		monolayer	4,300	2.1 -2.6	30-80
6-8	3.36-2.38	2	3,000	0.50-0.80	20-50
		2	4,300	0.40-0.70	15-40
		4	3,000	0.70-1.30	100-150
		4	4,300	0.60-1.10	20-60
		monolayer	3,000	1.0 -2.1	100-300
		monolayer	4,300	1.0 -2.0	40-150
4-6	4.76-3.36	2	3,000	0.80-1.4	150-400
		2	4,300	0.80-1.3	75-200
		4	3,000	0.80-1.3	100-300
		4	4,300	0.80-1.3	50-150

*Samples were obtained from propping sand used in field fracturing operations.
**Weight of propping sand divided by void volume of flow cell under no overburden load.
***Very small, not measured.

Larkin bull plugs and swage nipples are typical of the broad line of quality equipment stocked and distributed through National's 124 stores.

This is the NATIONAL SUPPLY STORE, too!

The next time you stop in a National Supply Store, remember to shop *behind* the counter, too. You'll see quality equipment like these Larkin products, Link-Belt Chain, Ajax Engines, Oilmaster Pumps, Tube-Turn fittings, Rockwell-Nordstrom Valves, Columbian Rope and many more. Wherever you go, National Supply offers you an unmatched variety of quality products.

On the next pages:
National Multi-String Wellhead Equipment

Two National Type E-24 Pumpers operate through this National dual completion assembly, located on the discovery well of an Alabama field.

10 major reasons for using NATIONAL Multiple String Heads

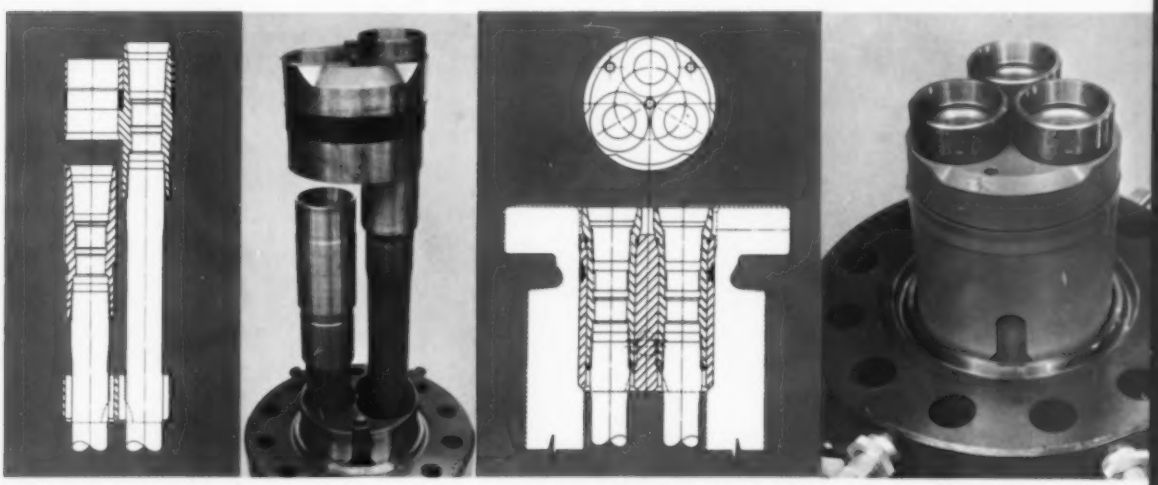
1. NATIONAL Multiple String Heads are available in four basic designs to suit any requirement . . . can handle applications from low-pressure pumping to high pressure gas or oil wells.
2. Provide maximum flexibility and safety.
3. Afford *complete independence* for each producing zone.
4. Handle completion cycle in manner similar to single completion . . . using same design of equipment, but reduced in size to permit handling two or more tubing strings.
5. The Laurent seal*—"sealed-in-steel"—is used for higher pressures.
6. Hangers are self locating.
7. Simplicity characteristic of conventional equipment is carried out in the multiple string design.
8. Adaptable to other manufacturers' wellhead bodies.
9. Plastics or liquids are not required to effect the seals.
10. National's many years of engineering experience stand behind the design of the multiple string equipment.

Get the details behind each reason from the National representative in your area now. And remember . . .

*Patent No. 2,687,229

You always get these advantages with any type of National Wellhead Equipment

Ease of assembly
Maximum flexibility
Pre-tested safety
Readily available stocks
Experienced advisory service



NEW ADDITION TO NATIONAL LINE—Type DP-4 dual string wellhead equipment†† is rated at 10,000 psi working pressure. It permits "controlled completions" through standard preventers. Retrievable mandrel gas lift valves can be run on either tubing string, and either tubing string can be pulled without disturbing the other.

TRIPLE-STRING WELLHEAD EQUIPMENT†—National Type TP-1, rated at 5,000 psi maximum working pressure. This hanger allows a triple string completion to be made with complete preventer control at all times. The TP-1 hanger is used in the DP-4 tubing spool to provide maximum flexibility.

†Patent Pending

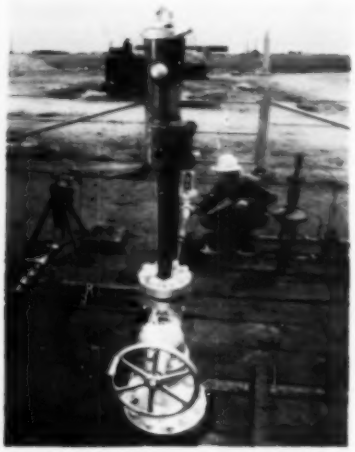
More on the next page . . .

A National Type E Long Stroke Pumping Unit in operation in California. National Pumpers are available in 13 basic sizes, with more than 90 standard specifications in beam and crank counterweighted types. There's one to suit any pumping need you may have!

Your best buy for every recovery method— NATIONAL production equipment!

Get reliable service from precision-made National Sucker Rods. They have top resistance to fatigue, shock, corrosion and impulse loads. Available in a range of grades to meet every well condition.

National Triplex Pumps are reliable on a host of oilfield pumping jobs including waterflooding, salt water disposals, formation fracturing, and as power-oil sources for sub-surface hydraulic pumps.



National Plunger Lift can be the best production method for certain types of wells. It uses formation gas or injected gas for operation, has low initial and service costs. Equipment is also available for gas well operation to remove liquids and maintain a uniform and increased flow rate of gas.

THE NATIONAL SUPPLY COMPANY

Subsidiary of Armco Steel Corporation

TWO GATEWAY CENTER, PITTSBURGH, PA.

DIVISION OFFICES: Calgary, Dallas, Denver, Houston, Toledo, Torrance, Tulsa

EXPORT: 600 Fifth Avenue, New York 20, N.Y., U.S.A.; City Wall House, Chiswell Street, London E.C.1

Litho in U. S. A.

you can have UNIBOLT FLOW MANIFOLDS any way you like them!

Here are half a dozen of the most popular arrangements of UNIBOLT Flow Manifolds. They range from low-cost, low-pressure threaded connections to low-cost, high-pressure UNIBOLT or API flanged connections. The Wing Valve may also be used as an Adjustable Choke (full open, it passes 10,000 bbls. of fluid per day with only a 100 lb. pressure drop). The Positive Choke Body, or Tee with Cage Nipple and Bean, may be fixed in any plane to facilitate flow line connections. The Wing Valve never needs lubricating and may be completely and inexpensively overhauled in the field. The Positive Choke Body is equipped with a coupling on the downstream end, saving the cost of a flowline coupling. All parts are standard UNIBOLT design, meaning complete interchangeability, and are available thru supply stores everywhere.

Lighter weight but greater strength, lower cost but no sacrifice in quality and all-around usefulness . . . that's the story of UNIBOLT Flow Manifolds.

THORNHILL UNIBOLT CRAVER CO.

P. O. BOX 1184 • HOUSTON, TEXAS

Sand-Propped Fractures

Table 2 gives the results of propping fractures with sand in formations where the embedment is very small. For these tests the amount of sand was varied from a partial monolayer to sand packs of three layers in thickness. Overburden pressures of 3000 to 4300 psi were used. Although the fracture widths and capacities measured in the study are reported quantitatively, they should be taken on a qualitative basis. Duplication of results was very difficult; thus ranges of the resulting fracture widths and capacities are reported.

There are several points of interest shown by these results. The data on the 20-40 mesh sand indicate that at low sand concentrations the fracture capacity would be below 50 md-ft for over burden pressures above 3000 psi. If the sand were concentrated in the fracture to the extent that a multilayer pack (three layers) was formed, the fracture capacity could be increased; however, this increased capacity is limited to the 200 to 300 md-ft range. A fracture in this range of capacity would be of limited value as an effective production stimulus except in those formations of a low order of capacity (i.e., 50 md-ft or less). For the 10-20 mesh sand, the fracture capacities obtained with low sand concentrations are only slightly higher than those obtained with the 20-40 mesh sand. If a multilayer sand pack could be obtained, a fracture capacity approaching 1000 md-ft should result. For the 6-10 mesh sand fractions, the flow cell would not permit a multilayer pack; for those concentrations tested, the fracture capacities were of the 10 to 100 md-ft range.

For each of the three mesh sizes listed in the preceding paragraph, there is a considerable range in the sizes of the particles within the sand fraction. Thus, because of point loading of the propping sand for sand concentrations of a monolayer or less, the grains are crushed to the extent that the resulting fractures are packed with very small particles. Fractures "propped" with packs such as these possess little permeability and result in small fracture capacities. For the multilayer packs where the sand grains are not point loaded by the fracture surfaces, crushing also occurs. However, the crushing is less than that which occurs at lower sand concentrations. In this case, the fines resulting from the crushing reduce the porosity of the pack to the extent that its permeability is only a small fraction of its original value.

The dat.. on the 6-8 and 4-6 mesh sizes of sand show that only limited increases in fracture capacity are obtained with the larger size sand. With the larger-size sand there are fewer particles per given concentration, and the grains in these sand fractions are usually less uniform in shape and size than those in the sand fractions discussed previously. As indicated by the data in Table 2, the larger-size sand as well as the smaller-size sand crushes. Thus, in formations where crushing of the propping sand is prominent, increasing the sand size to obtain greater fracture capacity is of limited value.

At this point it should be emphasized that the low-capacity fractures which result from the crushing of the propping sand would occur in those formations of sufficient hardness to permit only a very small embedment. If the propping sand is embedded sufficiently so that the grains are not point loaded, then the problem reverts to one of controlling the extent of embedment. This problem was discussed in a previous paper.[2]

Coated Sand Grains

The results of a limited number of tests in which 4-6 mesh sand grains on which a thin envelope of coating material had been placed are shown in Table 3. In 7 of the 9 tests, the flow capacities of the simulated fractures were in excess of 30,000 md-ft. These values are from 10 to over 100 times the fracture capacities obtained with the same size sand uncoated. Examination of the coated grains of propping sand (after subjection to loading) showed that the sand grains were crushed; however, the coating held the crushed fragments in place. The envelopes of coating materials containing the crushed sand act similarly to sand bags, and thereby serve as an excellent prop for the fracture.

TABLE 3. Flow Capacities of Coated-Sand-Propped Fractures.

Propping Agent*			Propped Fracture	
Size U. S. Mesh	Concentration** lb/gal	Coating	Overburden —psi	Average Flow Capacity —md-ft
4-6	0.50	Acrylic Plastic	3000	42,000
4-6	2.00	Acrylic Plastic	3000	10,000
4-6	0.50	Rubber Latex	3000	50,000
4-6	0.75	Rubber Latex	3000	90,000
4-6	1.50	Rubber Latex	3000	33,000
4-6	2.00	Rubber Latex	3000	3,000
4-6	0.50	Asphalt	3000	68,000
4-6	0.50	Rubber Latex	4000	48,000
4-6	1.50	Rubber Latex	4000	33,000

*Obtained from a 4-8 mesh propping sand used in a fracturing operation in Creek County, Oklahoma.
**Weight of propping agent divided by void volume of flow cell under no overburden load.

TABLE 4. Capacity of Shell-Propped Fractures.

Type of Shell	Width of Fracture (mm)	Fracture Capacity (md-ft)
Coconut	1.06	60,000
Peach Seed	1.24	46,000
Walnut	1.02	45,000
Pecan	0.64	32,000
Lemon Seed	0.18	890
Apple Seed	0.20	860
Grape Seed	0.53	350
Orange Seed	0.15	270

Test Conditions
Particle Size: 4-6 mesh U.S. Standard Sieve Series
Load: 3000 psi
Concentration: Approximately 4 particles per sq in., equivalent in number of particles to about 1¼ lb sand per gal fluid (sand weight divided by void volume of fracture under zero load).

Organic Materials

The organic materials evaluated were in the form of shells and seeds. Some 25 materials were used; however, only the results obtained with 8 of the materials are shown in Table 4 as representative of the range of fracture capacities obtained. In the case of a material such as coconut shell, the crushed material was screened to obtain the 4-6 mesh particles, whereas, for a material such as lemon seed, whole seeds of the 4-6 mesh were used.

In general, the laboratory data indicate that the crushed shells should be excellent for propping fractures in formations where embedment is very small. Under the conditions listed in Table 4, fracture capacities in excess of 30,000 md-ft were obtained. Like the coated sand grains of the same size, the fracture capacities are much greater than those obtained with the same size uncoated sand. However, for the seed material the fracture capacities were below 1000 md-ft, and this type of propping agent was considered unsatisfactory.

The most readily available shell material for field operations was the crushed black-walnut shell. A field trial was made in which the crushed shell was used as the propping agent. In this test a "screenout" occurred when less than 100 lb of the shells had been carried into the fracture. Although the fracturing job was of limited success (in that the well productivity was increased), it was evident that the angularity of the crushed shell was an undesirable feature of the propping agent. It was decided that for the crushed shell to be most suitable for field operations, the particles should be preferably rounded and the supplier of the shells was requested to furnish a rounded particle.

HALLIBURTON

LO-TORQ PLUG VALVE

surpasses existing field requirements

A new development by Halliburton... the most versatile plug valve ever designed for the higher working pressures and low torque operations... yet dependable under the most severe operating conditions. Its unequalled performance surpasses existing field requirements... is capable of carrying many varieties of fluids and slurries... in cementing, drilling, fracturing, acidizing and mud systems... functions at pressures to 15,000 psi... is strong and durable, yet light in weight.

Compare these features of the Lo-Torq plug valve with any other plug valve!

- **ECONOMY**... low initial cost—economical to maintain—parts easily replaced in the field.
- **DEPENDABILITY**... performs under the most severe and rugged field conditions—meets with Standard A. P. I. Testing Procedure for *drilling* and *production* plug valves.
- **DURABILITY**... body forging and adjusting nut of heat treated alloy steel is designed for greater dependability, minimum weight and maximum strength, passing destruction tests of 35,000 psi... split-tapered inserts permit easy one-time adjustment.
- **LOW TORQUE**... extremely low torque required makes valve more easily operated. Torque is reduced by use of a balanced cylindrical plug which is not subject to longitudinal loads. Simple adjustment sets the valve for the correct operating torque.
- **VERSATILITY**... performs with highest efficiency in all liquid, gas and slurry applications... in cementing, drilling, fracturing, acidizing, mud systems and numerous other applications.
- **AVAILABILITY**... immediate shipment of 1" or 2" sizes with split-tapered inserts in either non-ferrous alloy or durable cast iron direct from the factory at Duncan, Oklahoma.

Call your local Halliburton Representative... ask him for prices and new brochure on the "LO-TORQ PLUG VALVE" by Halliburton.

HALLIBURTON
CEMENTING SERVICES

"EXPERIENCE AND KNOWLEDGE... THE HALLMARK OF HALLIBURTON SERVICE"

HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA

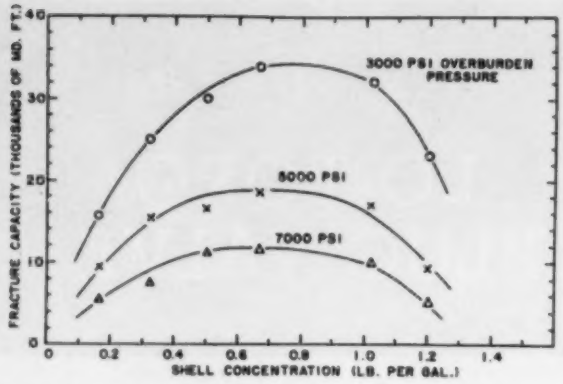


FIG. 4. **Fracture capacity** resulting from the use of 8-12 mesh rounded walnut shell as the propping agent.

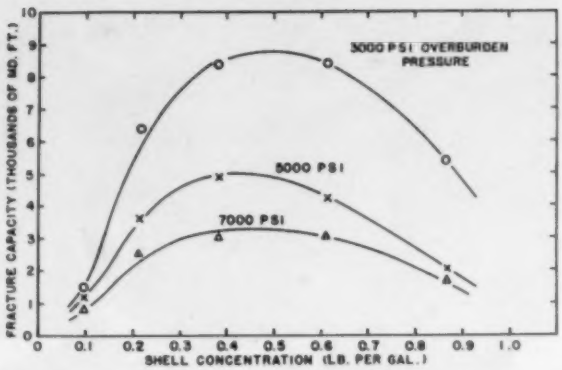


FIG. 5. **Fracture capacity** resulting from the use of 12-20 mesh rounded walnut shell as the propping agent.

Evaluation of Crushed Black-Walnut Shell

Laboratory evaluation. In the laboratory the rounded shell material was evaluated for the mesh sizes of 4-6, 6-8, 8-12, 12-20, and 20-40 (U. S. Sieve Series) under overburden pressures up to 7000 psi and for concentrations* up to 1.5 lb per gal. (The grain density of the walnut shell is about one-half the grain density of sand.) This evaluation was made with the flow cell which simulated a formation of such hardness that the propping agent would not embed. In practically all cases the fracture capacities obtained with the rounded walnut-shell particles were at least 100 times the fracture capacities obtained with the same size sand.

The results of the evaluation of the 8-12 and 12-20 mesh sizes of shell are given in Fig. 4 and 5. (Field application has been predominately with these two mesh sizes.) For the 8-12 mesh size shell, the maximum fracture capacity obtained under 3000 psi overburden pressure was 32,000 md-ft. The shell concentration for the maximum capacity was about 0.7 lb per gal. As the overburden pressure was increased to 7000 psi, a maximum fracture capacity of 11,000 md-ft was obtained at a shell concentration of about 0.6 lb per gal. Thus, for propping fractures under 3000 to 7000 psi overburden pressures in formations where the embedment is very small, the walnut-shell concentration desired in the fracture is 0.6 to 0.8 lb per gal.

For the 12-20 mesh size particles, less concentration of shell is needed for maximum fracture capacity than for the 8-12 mesh size. However, the values for the maximum capacities obtained with the 8-12 mesh particles are roughly four times those obtained with the 12-20 mesh particles. Under 3000 psi overburden pressure, a maximum fracture capacity of 9000 md-ft was obtained with a shell concentration of 0.5 lb per gal. As the overburden pressure was increased to 7000 psi, a maximum fracture capacity of 3500 md-ft was obtained at a concentration of about 0.4 lb per gal. Thus, for this range of overburden pressures the shell concentration desired in the fracture is 0.4 to 0.5 lb per gal.

Other data of interest obtained during the evaluation of the shell material pertain to the durability of the shells. In some of the tests the propping agent was subjected to the overburden pressures for times up to 65 hours without adverse effect on the fracture capacity. In other tests the walnut shells were stored in crude oil (at atmospheric pressure and temperature) for about 18 months. These shells were then evaluated and the results were essentially the same as cited previously. Also, the walnut shells were placed in hydrochloric acid (15 percent by weight) for a period of 2 days and then evaluated as a propping agent. No appreciable effect was noted.

*Weight of shell divided by void volume of flow cell under no overburden load.

Field evaluation. At the writing of this paper, the rounded walnut-shell material had been used as a propping agent in 6 fracturing operations. These operations were performed during a period of about 2 months. Data on 2 of the wells in which the shell material was used are discussed following.

The first use of the rounded shell material was in connection with a routine fracturing operation (upon well completion) in which gelled crude oil and sand were used. The well was completed in the Skinner sand formation (oil zone) in Noble County, Oklahoma, at a depth of about 5000 ft. The thickness of the Skinner sand in this case was about 9 ft. Laboratory tests indicated that propping-sand embedment in the formation would be very small and that the walnut-shell material would be a better propping agent than sand.

On completion, the well was perforated with an 8-way jet charge 1 ft below the middle of the pay formation. The formation was "broken down" with crude oil at a surface pressure of 3250 psig. Following this "formation break," the crude could be injected at 2300 psig. Then 5000 gal of gelled crude oil were injected at 12 bbl per min at pressures ranging from 2900 to 2600 psig. This was followed with 5000 gal of gelled crude oil containing 1 lb per gal of 20-40 mesh sand. At the 12 bbl per min rate, the injection pressure ranged from 2650 to 2600 psig. This, in turn, was followed with 2150 gal of crude oil containing 0.3 lb per gal of 8-12 mesh rounded walnut shells. The injection pressure for the gelled oil-shell mixture ranged from 2300 to 2000 psig for an injection rate of 12 bbl per min. A total of 650 lb of shells was placed in the fracture. The well was completed as a flowing well with a potential of 312 bbl per day.

A second well on which the rounded shell material was used and data are available is a gas well that was completed in the Tackett sand formation in Johnson County, Arkansas. In this well, two productive zones were found. One was a 10-ft zone at the depth interval of 3560 to 3570 ft and the other was a 5-ft zone at 3535 to 3540 ft. A drillstem test on the 10-ft zone gave 420 Mcf per day, while on the 5-ft zone the test gave 20 Mcf per day. Laboratory tests on core samples of the productive formations indicated that propping sand would crush in the fracture when subjected to the overburden load and that walnut shells would be a better propping agent.

The well was completed with casing set through the pay zones. The lower zone was perforated twice with an 8-way jet gun at 3565 ft, and a weak hydrochloric-acid solution was used as the breakdown fluid. A surface pressure of 2600 psig was required for the breakdown, and the injection pressure following the breakdown was 1100 psig. The pumping schedule on this zone was 8500 gal of gelled water with no propping agent, 16,500 gal gelled water with ⅛ lb per gal of 12-20 mesh rounded walnut shells, and 5000 gal

A National Super Deep-Well Coupling, containing two sections of 7⅝" O.D. Deep-Well Casing with Buttress-Thread. Each section projects 2" from coupling.

BEFORE

AFTER

The power hammer has driven one section of the casing into the coupling to meet with the other section. Both sections are a mass of distorted and twisted steel, yet the casing coupling did not fail.

How tough can a casing joint get?

National Buttress-Thread joint takes brutal pounding but remains intact!

Six times a 4000-pound steam hammer, under terrific velocity, slammed down onto the USS National Deep-Well Casing driving it into the Super-Deep-Well Coupling. Inside the coupling, the threads played leapfrog—the two sections of casing met in the middle of the coupling, and climbed all over each other. With each smashing blow, the coupling "bellied" out until it began to look like a buckled barrel. But it remained intact.

How tough can deep-well drilling get?

This test is a simulated drop test, designed to approximate, as closely as possible, severe field conditions. Although the test is more severe than any shock load a string of casing might encounter in the hole, it does prove conclusively that the Buttress-threaded and coupled joint is more than ready to withstand the tough deep-well stresses.

In addition to this drop test, many hydrostatic and galling tests have been made at the mill on the Buttress-Thread joint, with highly successful results. The high tensile strength of the patented Buttress-Thread joint is due largely to the combined effect of the completely engaged runout threads and the three-degree flank angle of the thread which supports the weight of the casing in the well. The joint is virtually as strong as the body of the pipe.

For further information on National Seamless Threaded and Coupled Casing, or these other National Seamless Oil Country Products —Deoxidized Bessemer Steel Casing and Tubing, Warm-Worked Casing, Threaded and Coupled Drill Pipe, *Deep-Well* Casing, *Super Deep-Well* Casing, and Hi-Pres-Sure External-Upset Tubing—write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Export Distributors: United States Steel Export Company, New York.

USS and National are registered trademarks

National Tube Division of United States Steel

The world's largest and most experienced manufacturer of tubular products

gelled water with ¼ lb per gal 8-12 mesh rounded walnut shells. The injection rate (down 5½-in. casing) was 39.8 bbl per min at 1100 to 1200 psig injection pressure.

The upper zone was treated through 3½-in. tubing after the 5-ft interval was perforated with 2 jet shots per ft. This zone was also broken down with a weak acid solution at a surface pressure of 3150 psig. The pumping schedule for this zone was 3000 gal gelled water, followed by 5000 gal gelled water containing ⅛ lb per gal 12-20 mesh rounded walnut shells, and 2000 gal gelled water containing ¼ lb per gal 8-12 mesh rounded walnut shells. The injection rate was 21 bbl per min at pressures ranging from 2200 to 2900 psig. Although a final potential test has not been made, a recent test resulted in 2060 Mcf per day through ¾ in. choke with a tubing pressure of 70 psig and casing pressure of 240 psig.

It should be noted that the concentrations of shells placed in the fracturing fluids used for the two wells are much less than the concentrations for maximum fracture capacities shown in Fig. 4 and 5. The concentrations cited as used in the fracturing operations were those obtained at the blender, whereas, in Fig. 4 and 5, the concentrations are based on the void volume of the fracture. In designing the mechanics of the treatment, the concentration of propping agent at the blender needed to obtain the desired concentration in the fracture is determined from data on fluid loss, injection pressure, and pumping rate. In this respect, each fracturing operation is unique and the concentration of shells needed at the blender should be determined for the specific fracturing operation.

The results of using the rounded walnut shells in field fracturing operations indicate that only a minor precaution is necessary with respect to handling or placing the propping agent. Because the density of walnut shells is approximately one-half that of sand, the number of particles per pound is approximately twice that of sand. Thus, in a continuous operation where the propping agent is fed to the blender via screws, the density difference has to be considered. Also, because of the density difference there should be less tendency of a screenout with the shells than with sand of the same particle size.

SUMMARY AND CONCLUSIONS

This study pertained to the propping of fractures in formations in which propping sand would crush rather than embed under the weight of the overburden. The results of the study show that for this condition a tougher and more pliable material would be a better propping agent than sand. One of these materials, a rounded crushed walnut shell, has been tested in field operations and its use presents no problems other than those encountered with propping sand.

1. Some formations are of such hardness that propping sand crushes rather than embeds under the overburden load. For a particular formation of this type and a particular propping sand of concentrations of a monolayer or less in the fracture, the equations describing point loading can be used to predict at what loads the sand grains will crush.
2. Sand grains around which there exists a tough pliable envelope are an effective propping agent for fractures in formations in which propping sand is crushed.
3. Sized particles of certain organic materials such as the shells of coconuts, peach seeds, walnuts, and pecans are an effective propping agent for fractures in formations in which propping sand is crushed.
4. Rounded crushed walnut shells can be used as a propping agent in field fracturing operations and their use presents no inherent operational difficulty.

ACKNOWLEDGMENT

The walnut shells used in this study were furnished by the Cherokee Laboratories, Inc., Tulsa, Oklahoma. Their cooperation in obtaining a rounded walnut shell particle is appreciated.

References

1. Dehlinger, P.; Browne, W. H. and Bundrant, C. O.: Trans. Am. Inst. Mining and Met. Engineers (Petroleum Development and Technology) 201, 273 (1954).
2. Huitt, J. L. and McGlothlin, B. B. Jr.: The Propping of Fractures in Formations Susceptible to Propping-sand Embedment, Paper No. 801-34-B, presented at the spring meeting of the Pacific Coast District, Division of Production, Los Angeles, Calif., May 22-23, 1958, to be published in *Drilling and Production Practice* (1958) (in press).
3. Hertz, H.: *Jour. Math.* (Crelles Jour.), Vol. 92 (1881) or *Gesmmelte Werke*, Vol. 1 p. 155, Leipzig (1895).
4. Timoshenko, S. and Goodier, J. H.: *Theory of Elasticity*, McGraw-Hill Co., New York, 375-376, 1951, 2nd Edn.
5. Sosman, R. B.: *The Properties of Silica*, Chemical Catalog Co., New York, 480-482, 1927.

Wilson, Staudt to Lead PESA

Wallace D. Wilson of Houston, Texas, has been elected president of the Petroleum Equipment Suppliers Association at meeting recently in Boca Raton, Florida. Wilson is president of Wilson Supply Company, Engineered Oil Tools Company and Wilson Foundry and Machine Company. A veteran of 46 years in the supply business, Wilson succeeds William T. Powell, executive vice president of Continental-Emsco Company, Dallas.

Newly elected vice president of PESA is John G. Staudt, executive vice president and a director of Dowell Division of Dow Chemical Company, Tulsa, Oklahoma.

H. R. Stafford, Jr., was re-elected executive secretary of the organization.

At the recently-held annual meeting, the group chose to redistrict the association into five areas, with 10 directors from each of the five districts. Also serving on the board of directors are 12 directors at large, all past presidents of PESA.

Wallace D. Wilson

John G. Staudt

The 13 new directors on the board of 62 are: W. H. Greer, Greer Supply Company, Owensboro, Kentucky; F. E. Rath, Spang & Company, Butler, Pennsylvania; G. W. Carrington, Exner-Dodge, Inc., Coffeyville, Kansas; John Eastman, Eastman Oil Well Survey Company, Denver, Colorado; T. N. Shults, Mid-Continent Supply Company, Fort Worth; R. D. Poindexter, Superior Iron Works & Supply Company, Inc., Shreveport, Louisiana; L. L. Rector, Rector Well Equipment Company, Inc. Fort Worth; George B. Coale, Baroid Division, Houston; John Maher, Reed Roller Bit Company, Houston; Frederick W. Richmond, Houston Oil Field Material Company, Inc., Houston; A. S. Marshall, H. C. Smith, Oil Tool Company, Compton, California; E. J. Weis, Pacific Pumps, Inc., Huntington Park, California, and E. K. Wilson, Shaffer Tool Works, Brea, California.

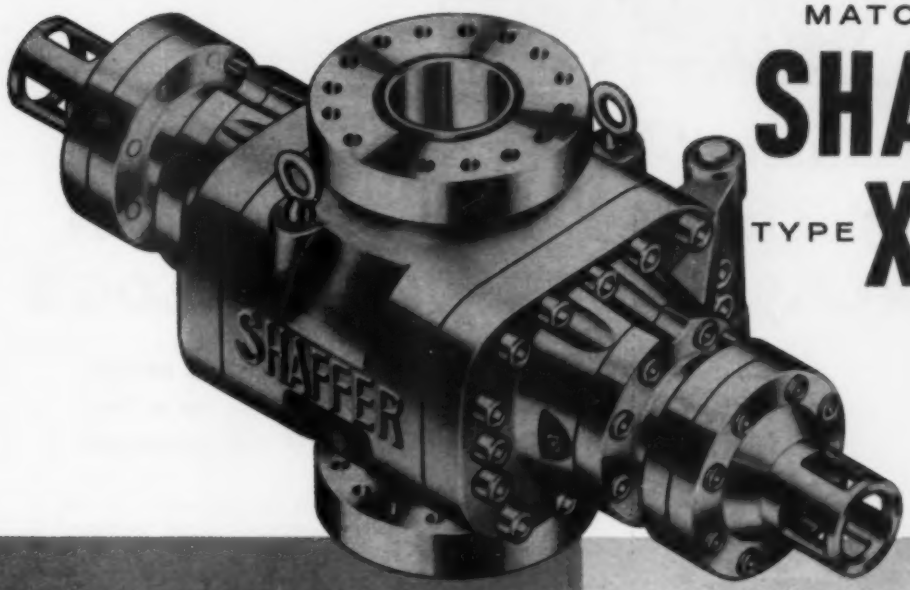
As redivided, districts are: Eastern district, Gulf Coast district, Northern Mid-Continent district, Pacific district, and Southern Mid-Continent district. Prior to the change, the association was grouped in four areas.

The 12 directors at large are: E. S. Dulin, Byron Jackson Tools, Inc.; Jack Crawford, Youngstown Steel Products of California; Frederick F. Murray, Oil Well Supply Division of United States Steel; A. W. McKinney, National Supply Company; Ted Sutter, Baker Oil Tools, Inc., F. M. Mayer, Continental-Emsco Company; M. B. Jones, S. M. Jones Company, Division of Buffalo-Eclipse Corporation; D. D. Bovaird, Bovaird Supply Company; M. E. Montrose, Hughes Tool Company; Rainey Elliott, Jones & Laughlin; Grover Kilgore, Halliburton Oil Well Cementing Co., and W. T. Powell.

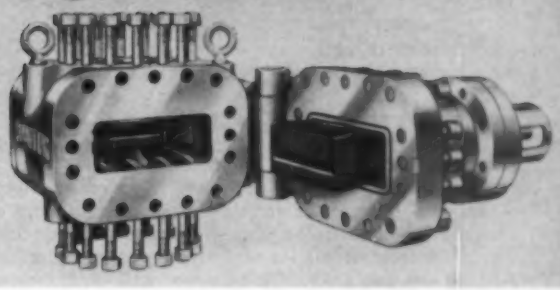
NOTHING in Blowout Preventers

MATCHES THE

SHAFFER TYPE XHP



THERE'S FAR MORE to building a high pressure blowout preventer than just meeting a pressure rating. But if pressure rating is your first consideration, take a look at the kind of *extra high* pressures the Type XHP can handle . . .



- **7-1/16" Bore Size—22,500 PSI Test Pressure, 15,000 PSI Working Pressure!**
- **9" and 11" Bore Sizes—15,000 PSI Test Pressure, 10,000 PSI Working Pressure!**

But That's Only Part of the XHP Story.
Although it has an extra high pressure rating, the Type XHP is not clumsy to service nor cluttered in its design.

TO CHANGE RAMS or service the ram compartment you simply unbolt and swing the end doors open. And there's the ram on one side for easy access—the open ram compartment on the other side for checking or service.

Best of all, you don't break hydraulic lines or lose hydraulic fluid each time you open the XHP. Hydraulic lines are built into the body—*and the hinge pins*—for leak-tight operation whether the door is open or closed.

AND, OF COURSE, the Type XHP has such other Shaffer advantages as QUICK-DRAINING RAM COMPARTMENTS, with the rams traveling on guide ribs high above any mud or sand that may collect in the compartment bottoms . . . and COMPLETELY ENCLOSED DESIGN with no exposed operating parts to become jammed or damaged by timbers or objects falling into the cellar.

COMPARE feature by feature and you'll find that nothing on the market equals the Type XHP for high pressure work combined with operating dependability and simple maintenance.

36 years OF OIL TOOL LEADERSHIP

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6606 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Shaffer Tool Works, 6201 South Shields Boulevard
FARMINGTON, NEW MEXICO, Shaffer Tool Works, Post Office Box 546
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
HOUMA, LOUISIANA, Shaffer Tool Works, Post Office Box 827
EXPORT SALES OFFICE, Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

THIS FREE 12-PAGE BROCHURE gives you complete facts and figures on the Shaffer Type XHP. Write or phone your nearby Shaffer representative for your free copy!

fracturing symposium

Stimulation Treatment Selectivity Through PERFORATION BALL SEALER TECHNOLOGY

Use of small balls to seal certain open perforations permits zones to be treated selectively. Here is a discussion of the principles and procedures for the design of such a treatment

Robert Wade Brown and Raymond G. Loper
The Western Company, Midland, Texas

THE PERFORATION BALL SEALER process is providing the industry with a method of well stimulation allowing a high degree of selectivity. The selectivity is coupled with an attractive economic advantage.[1] The higher degree of selectivity permits greater production and ultimate recovery from producing wells.

The purpose of this article is to outline the best known principles and procedures for obtaining a successful ball sealer treatment and to illustrate some of the recent improvements and some of the research problems that were conceived by the ball sealer process. Generally, the discussion will cover conditioning the well, treating string, selection of a ball sealer, ball sealer efficiency, and ball sealer treatment design procedure.

Conditioning the Well

Perforated zones. The first and perhaps most important factor to consider in the design of a successful ball sealer treatment is the perforating program. The first consideration in the perforating program would be the zones to be perforated. Realizing that communication is a serious detriment to the success of any type selective treatment, care should be taken to minimize the tendencies of the perforations or zones to communicate.

In order to accomplish this, the most porous sections of the formation are selected and perforated leaving the maximum cement blank between zones. Not only will zone perforating tend to reduce communication, but it also enhances the possibility of forming several fractures, one in each zone, rather than a single common fracture.

Shot density. Once the zones have been selected, the shot density becomes a predominant factor in the perforating program. A minimum shot density has less tendency to shatter the cement; but, more important, it forces the treating fluid to flow through fewer holes and thereby increases the ability of the perforation to attract a ball sealer. A number of operators have decreased the length of continuous zone perforated and the shot density from as many as eight perforations per foot to two perforations per foot. This has reduced the completion cost and has resulted in increased production from both conventional treatments and ball sealer treatments.

As was pointed out, one of the important benefits achieved from reduced shot density is less tendency to shatter the cement, thereby reducing communication problems. To further reduce shattering and communication problems, several companies have adopted the procedure of shooting the cement after about 18 hours or before the cement has cured. (The time interval is dependent on the well condition and type of cement used.) At this time, data are lacking concerning the results of shooting uncured cement to reduce communication problems, but as operators continue this practice, the data will become available to allow evaluation of the effects.

Perforation size. Also, along with a reduction in shot

Robert Wade Brown *(left) is a research chemist for The Western Company at Dallas, Texas. He holds a BS and MS degree in chemistry from North Texas State College at Denton, Texas, where he also was a student instructor and graduate tutor. He is a member of Alpha Chi Sigma, The American Chemical Society, AIME, and the Dallas Petroleum Engineers Club. Prior to joining Western he was a chemist for Temco Aircraft Corporation at Grand Prairie, Texas.*

Raymond G. Loper *(right) was graduated from the University of Oklahoma with a MS in petroleum engineering and is division logging sales engineer with The Western Company. He has worked for various companies in Oklahoma and the Louisiana Gulf Coast. He has been assistant professor of petroleum engineering at the University of Oklahoma and was later associate professor at Louisiana State University. He has been employed by Western since 1954.*

NEW
NEW
NEW
NEW
NEW
NEW

Martin-Decker Electric Drilloger Recording Systems

For the recording of Total Hook Load, Pump Pressure, Pump Speed, Rotary Speed, Torque, Rate of Penetration, and R. P. M. Signals, and Pressure Signals to 20,000 pounds . . . Write for Bulletin No. P90.

SEE IT AT THE
TULSA and NEW YORK
OIL SHOWS

M/D

MARTIN-DECKER CORP.
HOME OF THE WEIGHT INDICATOR—LONG BEACH, CALIFORNIA

density, it is sometimes wise to shoot perforations of larger diameter. For example, instead of using the standard ⅜-in. jet charge, perforate with a larger jet charge that produces a ½-in. diameter perforation. These larger holes allow production of the reservoir without an excessive number of perforations. Another, perhaps secondary, advantage of these larger perforations is that, because of the larger area, the hydraulic force which tends to hold the ball on the perforation is greater since this force is directly proportional to the area of the perforation.

The amount of fluid that a perforation will accommodate is proportional to its area. A ½-in. perforation will accommodate approximately twice the volume of the ⅜-in. perforation, assuming a constant differential pressure. This means that during any particular time interval, twice as many ⅜-in. perforations are required to accommodate a given volume of fluid. This indicates that at least one-half the number of ball sealer stages are required for a number of ⅜-in. perforations as are required for the same number of ½-in. perforations. This can be a disadvantage to the larger perforations and becomes critical if either the frac volume or the injection rate is limited.

The perforating program should be designed to provide a sufficient number of perforations to accommodate the horsepower planned for the well treatment. That is, the perforating program should be designed to accommodate the injection rate without imposing an excessive pressure restriction. This allows optimum utilization of the horsepower, and therefore obtains the most for the fracturing dollar.

Treating String

After the well has been perforated, the next consideration will be whether the well is to be treated through the casing, through the tubing, through the annulus, or through the tubing and the annulus. The importance of the treating string to the success of the ball sealer treatment should be readily recognized.

Casing treatment. For example, consider the conventional casing treatment. In this case there is a minimum restriction imposed and high injection rate treatments are obtainable. This is very advantageous in designing the ball sealer treatment both from the standpoint of fluid velocity down the casing and, mainly, from the standpoint of fluid velocity through the perforation.

The only obstacle encountered with casing treatments is that in some cases the anticipated treating pressure is above the yield pressure of the casing and makes casing-type treatments impossible. In the event that the well will treat above the casing yield pressure, it would be necessary to run tubing and packer into the well and treat the well through the tubing.

Tubing treatment. Tubing-type treatments present several problems and factors that affect the success of ball sealer treatments. The injection rates are limited due to higher treating pressures which are encountered as a result of increased friction pressure. Care must be taken to set the tubing at least 20 to 60 ft above the top perforation. This distance from the end of the tubing to the top perforation is required in order to allow the flow to attain a steady state after entering the casing below the tubing. Another factor that should be considered is that the flow rate in the tubing is not the controlling factor with respect to ball sealer efficiency. The fluid velocity in the casing below the tubing determines efficiency. An injection rate, for example, of 4 bbl per min in the tubing represents a quite high fluid velocity, but this is not the velocity that controls the ball sealer efficiency. The velocity that controls the ball sealer efficiency is the 4 bbl per min in the casing below the tubing.

When the subject of ball sealer efficiency versus fluid velocity is discussed later, it will become apparent that an injection rate of 4 bbl per min in 5½-in. casing is approaching the critical velocity range and results in an anticipated statistical ball sealer efficiency in the range of 85 to 95 percent. If this injection rate is increased to 7 bbl per min, the efficiency is statistically 100 percent, which eliminates a great portion of the problem of trying to allow for a decreased efficiency in the number of balls required per stage. Also due to the low injection rate only a few perforations need be open at a given time. This gives rise to great numbers of ball stages.

Annular treatment. The other condition, annular treatments, (performed either down the annulus and the tubing or the annulus alone) will be considered next. In cases where the well is to be treated down the annulus and the tubing, the balls may be introduced either through the tubing or through the annular space. In most annular treatments the injection rate is of sufficient magnitude to allow a reasonable ball sealer efficiency. In view of this, the ball sealer efficiency is usually not a problem. However, the tubing being situated in the well may pose a problem. The tubing, once again, is positioned above the top perforation to allow the fluid flow to stabilize and to eliminate any physical obstruction that might tend to prevent the ball from finding the perforation. In this case, especially, the ball sealer efficiency is a function of not only velocity but of position. That is, if the ball is across the casing from the perforation that is

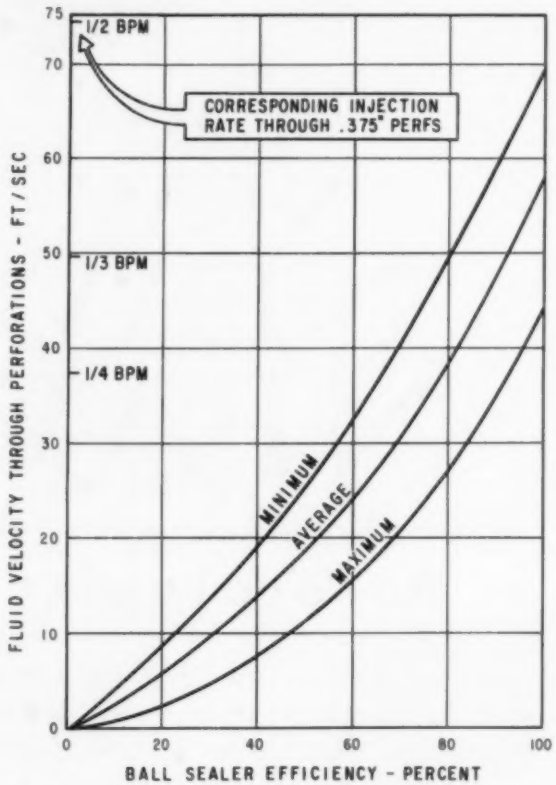
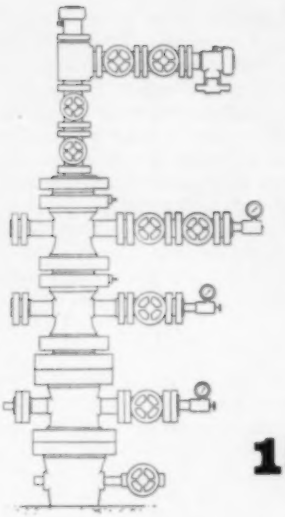


FIG. 1. **Test results** indicate that fluid velocity through perforations is the most critical controlling factor. Test conditions: (1) 5½-in. casing nipple perforated with 8 jet charges, each approximately ½-in. in diameter; (2) 7-in. casing nipple perforated with 24 jet charges, each approximately ⅜-in. in diameter. The ⅞-in. rubber balls were carried in water. Fluid velocities in the perforations and casing were varied by changing the injection rate into the casing nipples.



Rector

INSURES SAFETY
AND ECONOMY
AT WORKING
PRESSURES TO

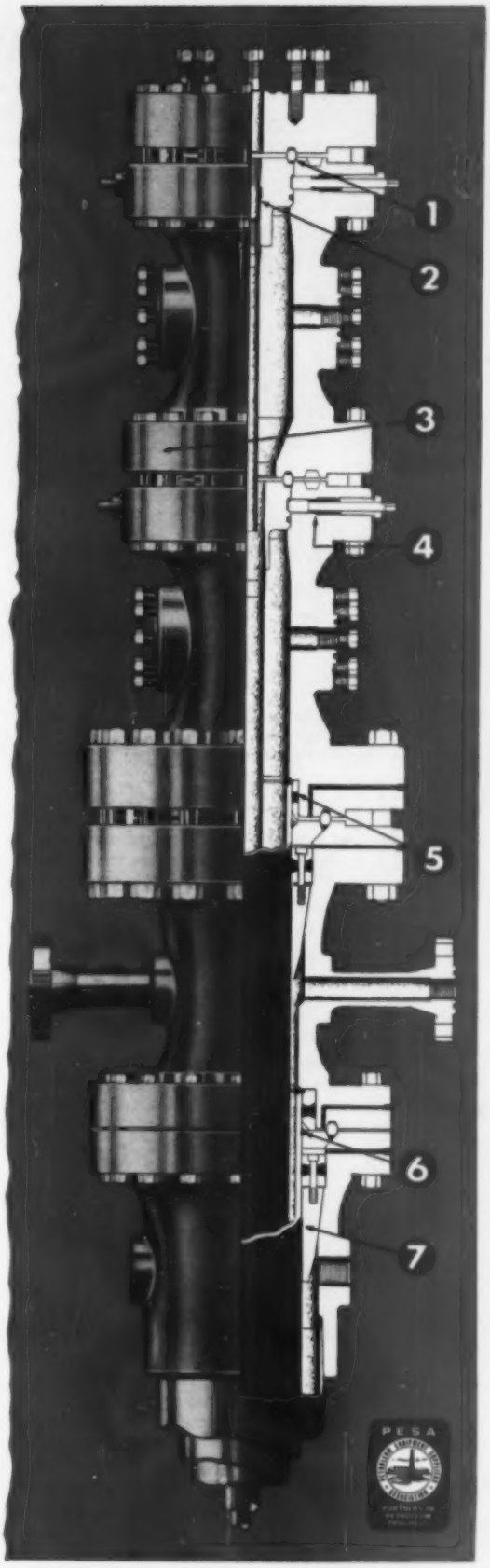
15,000 psi

WHEN PRESSURES RUN HIGH, RECTOR gives you control that is absolute. Exclusive *seal-with-steel* feature means positive *metal-to-metal* seal that is the trademark of Rector design and safety.
Rector equipment meets all standards of the API and the Association of Well Head Equipment Manufacturers. Tested to 22,500 psi as stipulated in API Test Specifications.
Check these features that make Rector well head equipment the standard of the oil industry.

1. **Permanent "seal-with-steel" between strings.**
2. **Mandrel recessed for RECTOR-PSI full opening back pressure circulating valve.**
3. **All flanges are API flanges.**
4. **Ground joint seat for "metal-to-metal" seal permits replacement of organic packing under pressure.**
5. **Optional auxiliary secondary pack-off with organic packing "floating ring" seal.**
6. **Permanent "metal-to-metal" seal does not require replacement or maintenance.**
7. **"Balance slip" suspension with self-actuated sealing mechanism.**

MONOGRAMMED EQUIPMENT — CERTIFICATE NO. 2158

Be safe! Be sure! Buy Rector quality!
See your Rector representative or your favorite supply store.



RECTOR

MAKING THE OIL INDUSTRY SAFER

WELL EQUIPMENT CO., INC.

1100 North Commerce
Fort Worth, Texas
Houston Plant: 2215 Commerce Street

EXPORT REPRESENTATIVES
Continental-Emsco Co.
Mid-Continent Supply Co.
Oil Well Division of United States Steel Corp.

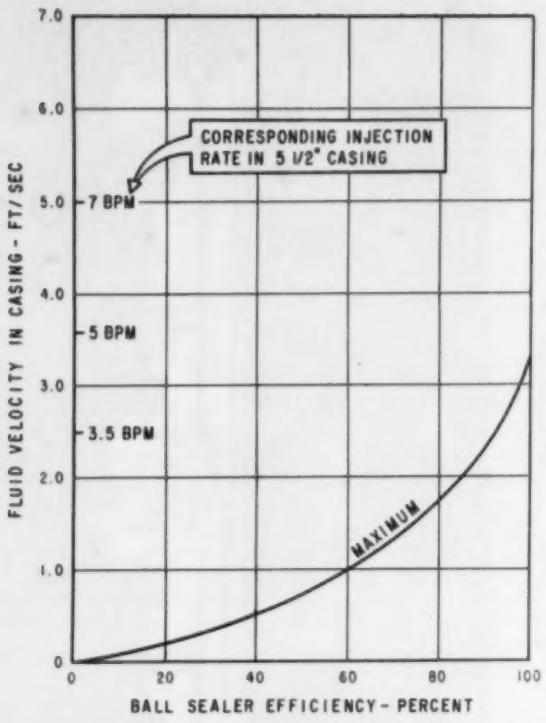


FIG. 2. Ball sealer efficiency as a function of fluid velocity in 5½-in. casing illustrates 100 percent efficiency is reached at less than 3.5 ft per sec. Test conditions are the same as those shown in Fig. 1.

taking the fluid, chances are the vertical forces on the ball would not be of sufficient magnitude to overcome the fluid drag that is trying to pull the ball into the perforation. In this case, the ball would proceed past the hole.

As was pointed out, there are two ways of injecting the balls in these treatments — either down the tubing or down the annular space. If the balls are injected down the tubing, less fluid displacement is required to carry the balls to the perforated interval. In many cases, this is desirable, especially if the total volume of fracture fluid is limited and the number of ball stages is relatively large. If the balls are injected through the annular space, care should be taken to ascertain that the ball will have sufficient clearance. For example, the standard ⅞-in. ball should not be injected down the annulus between 2-in. or 2½-in. tubing hung in 4½-in. casing. In this latter example, the balls could bridge in the annular space and result in a treatment failure.

Selection of Ball Sealer

Assuming that the well has been adequately conditioned, the next factors that affect the success of a ball sealer treatment concern the properties of the ball sealer to be employed. Ball sealers differ in construction and size. Test results have shown that the optimum ball sealer for perforations up to ½-in. diameter is the ⅞-in. solid rubber ball. This ⅞-in. solid rubber ball will withstand treating temperatures* of up to 200 F and pressure differentials of up to 10,000 psi. The pressure and temperature limitations will allow the rubber balls to be used in practically any treatment of any depth well. (The 10,000-psi pressure limitation is recognized as a gross extreme since it is in excess of the internal yield pressure of nearly all oilfield tubular goods.)

*Treating temperatures are, as a rule, substantially lower than static bottom-hole temperatures.

For non-conventional perforations — for example, cases where open hole charges are shot in casing — large diameter balls may be required. In most cases solid rubber balls are advantageous under these conditions; however, certain factors could designate the use of ball sealers other than solid rubber, such as rubber-covered nylon or solid nylon. The main disadvantage to the use of nylon or rubber-covered nylon balls is the fact that they rarely enact a positive seal. Any area of the ball exposed to fluid leaks will be eroded. Rubber-covered nylon and nylon balls have been recovered which were abraded by sand flow to as little as one-half their original size. A ball sealer so abraded could very easily enter the perforation and impede the well's productivity.

Ball Sealer Efficiency

Ball sealer efficiency is the ratio of the number of holes sealed to the number of balls injected. For example, if 100 balls were injected and 100 perforations were sealed, the resulting efficiency would be 100 percent.

There are many factors that affect the efficiency of ball sealers; (A) fluid properties, (B) fluid velocity in the casing, (C) fluid velocity through the perforation, (D) physical characteristics of a ball, (E) probability, etc. Of these factors, tests results indicate that the velocity of the fluid through the perforation is the most critical controlling factor. Considering the ⅜-in. perforation, the perforation velocity equivalent to about ⅓ to ½ bbl per min per perforation has been found to produce statistically 100 percent efficiency. (See Fig. 1.) If the rate is decreased from this flow per perforation, the efficiency accordingly decreases. At rates of flow above ⅓ to ½ bbl per min per perforation through ⅜-in. hole, efficiency remains statistically 100 percent. Varying the pipe velocity or the injection rate in the casing also affects the ball sealer efficiency (See Fig. 2.);

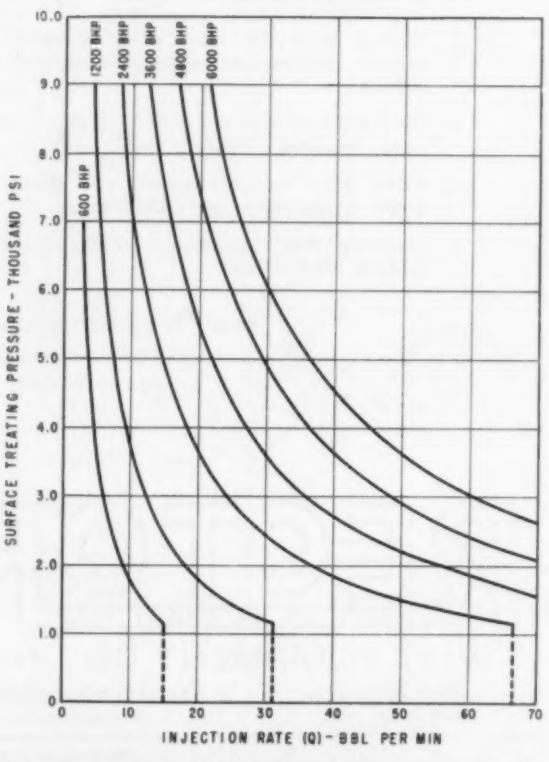


FIG. 3. Horsepower chart depicts injection rate versus surface treating pressure anticipated in the design of the treatment.

The Paul Bunyan of the Oil Fields

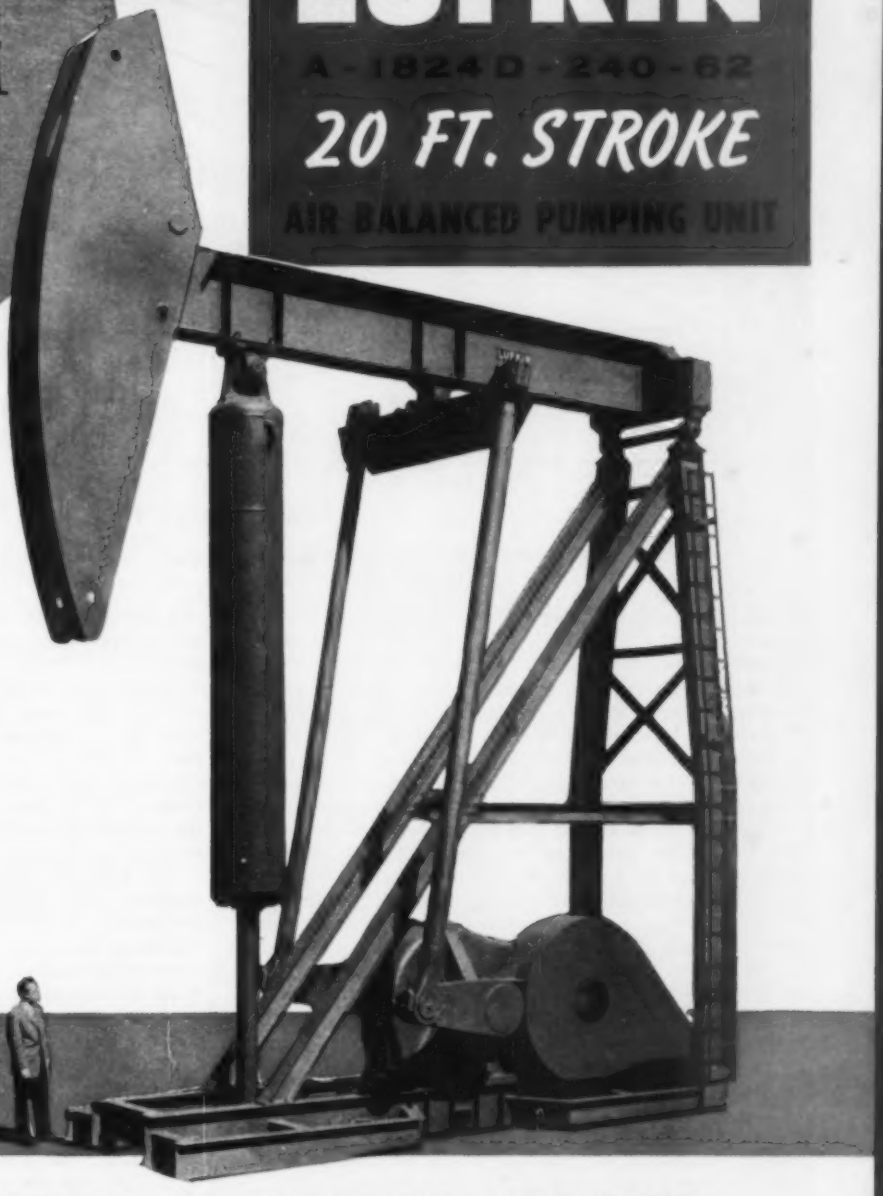
THE MIGHTY

LUFKIN

A-1824D-240-62

20 FT. STROKE

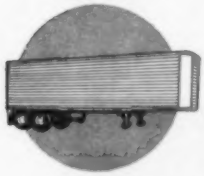
AIR BALANCED PUMPING UNIT



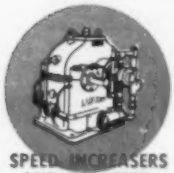
- Peak Torque — 1,824,000 in. lb.
- Stroke — 240 in. maximum
- Polished Rod Capacity — 62,000 lb.
- Overall Height *(top of stroke)* 46'-10"

PUMPING UNITS

GAS ENGINES



TRAILERS



SPEED INCREASERS AND REDUCERS

• THERE'S NO PUMPING JOB TOO BIG OR TOO TOUGH FOR *LUFKIN!*

LUFKIN FOUNDRY & MACHINE COMPANY

LUFKIN, TEXAS

Branch Sales and Service HOUSTON • NATCHEZ • CORPUS CHRISTI • LAFAYETTE • DALLAS • KILGORE • ODESSA • HOBBS • GREAT BEND • DENVER SHREVEPORT • WICHITA FALLS • LOS ANGELES • BAKERSFIELD • EFFINGHAM • CASPER • OKLAHOMA CITY • SIDNEY • MIDLAND FARMINGTON • SEMINOLE • TULSA • NEW YORK • PAMPA • STERLING • MARACAIBO, VENEZUELA • ANACO, VENEZUELA

Lufkin equipment in Canada is handled by THE LUFKIN MACHINE CO., LTD., 9950 65th Avenue, Edmonton, Alberta, Canada, Regina, Saskatchewan, Canada

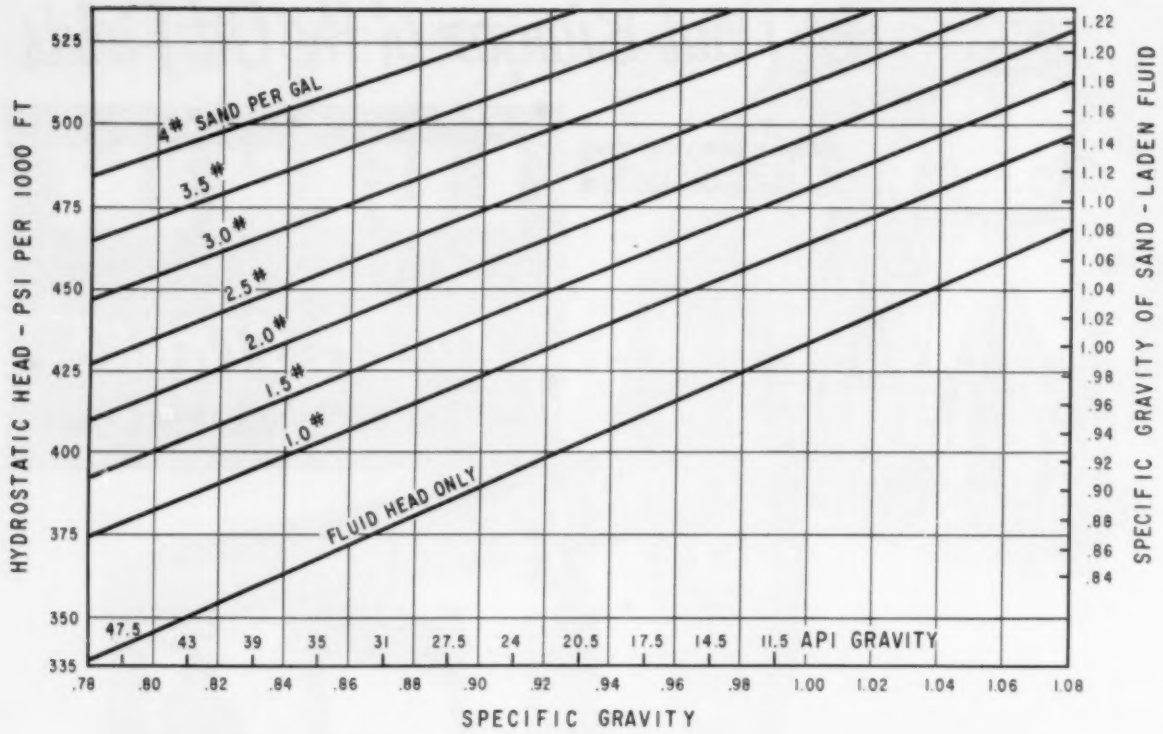


FIG. 4. Correction chart for determining effective gravity and hydrostatic head of sand-laden fluid.

but the flow through the perforation is indicated to be the prime concern.

These factors, being somewhat elusive in nature, pose quite a problem in determining the weighted effects of each. In order to overcome this obstacle, experimental tests were conducted and the relationship between fluid velocity, fluid properties, ball characteristics, etc., were determined empirically. As far as these tests were able to indicate, the main effect of the fluid velocity in the casing is its tendencies to minimize the effect of the terminal velocity of the ball. That is, as the casing velocity increases, the proportionate effect of the terminal velocity of the ball on the final velocity of the ball is minimized. It is possible to calculate the final velocity of the ball by using Stokes' equation to calculate terminal velocity for large particles in turbulent flow and adding the initial velocity of the ball as it enters the casing string.

Once the ball seats on a hole, another problem is introduced; the effect of the flow of fluid in the casing past the ball. In order to calculate this drag on the ball, several assumptions were made. Investigation disclosed that these assumptions were practical and, using a modified Newton's equation, it was discovered that if about 20 lb of force resulted across the ball, the ball would not be dislodged from perforations (½-in. in diameter) by flow in 5½-in. casing. This is because that at pump rates sufficient to dislodge the ball, friction pressure is sufficient to cause the pipe to rupture. Once the balls are seated, care should be taken to avoid any equipment shutdowns. If the differential across the ball is removed, the resilience of the ball will cause it to free itself from the perforation.

Ball Sealer Treatment Design

After the well has been properly conditioned and the proper ball sealer has been selected, the next problem is to determine how many balls to run, how many stages to use, and how many balls to use per stage. A tested method for selecting ball sealer stages and selecting the number of balls to use in a particular stage is based on a study of the flow of fluid through perforations and is substantiated by mathematical calculation based on a modified Bernoulli equation. The work done by Marion H. Stekoll[2], Stekoll Petroleum Company, stimulated a lot of work in this direction. Bob C. Crittendon[3], Magnolia Petroleum Company, and Richard W. Coburn[4], W. E. Stiles Engineering, have also contributed to the advancement of the theories by their publication of treatment studies and ideas.

The following step-wise treatment design procedure is engineered to result in the breakdown and treating of each perforation — provided, of course, that the perforations will break down at a pressure lower than pipe maximum. (In a single continuous zone, it is usually not necessary to break down more than 6 to 10 perforations to allow production of the reservoir; however, when two or more separate zones are perforated, each perforation must be broken down and treated in order to be certain that all zones have been opened.)

Step 1. Select the horsepower chart depicting the rate vs pressure that is anticipated for the treatment being designed. See Fig. 3. (For treatments with injection rates less than 15 bbl per min use a horsepower chart with an expanded bbl-per-min scale.)

Step 2. Determine the surface injection pressure at zero injection rate.

This may be accomplished by one of the following:

(a) If no previous treatments are available on the well, the surface injection pressure can be determined by breaking down the well, establishing an injection rate, and observing the instantaneous pressure drop when all pumps are stopped. The resulting pressure is the instantaneous shutdown pressure or surface injection at zero injection rate. (The injection rate must be sustained long enough

" . . . advanced technology and methods"

"In an industry such as ours, an industry whose accomplishments are little short of phenomenal, it is difficult to praise any one segment without deep consideration.

"Great contributions have been made by all elements. Cooperation between operating companies, manufacturers, drilling contractors, and service and supply companies has made possible the growth and progress our industry enjoys.

"Service companies, for instance, have given us advanced technology and methods for finding and producing oil and gas. These services are available when and where they are needed, at any time day or night, in any weather.

"Behind each drilling rig, each refinery, each gas plant or pipe line operation stands the manufacturer, the supplier and the service man. They provide engineering, research, products and services to keep the industry humming.

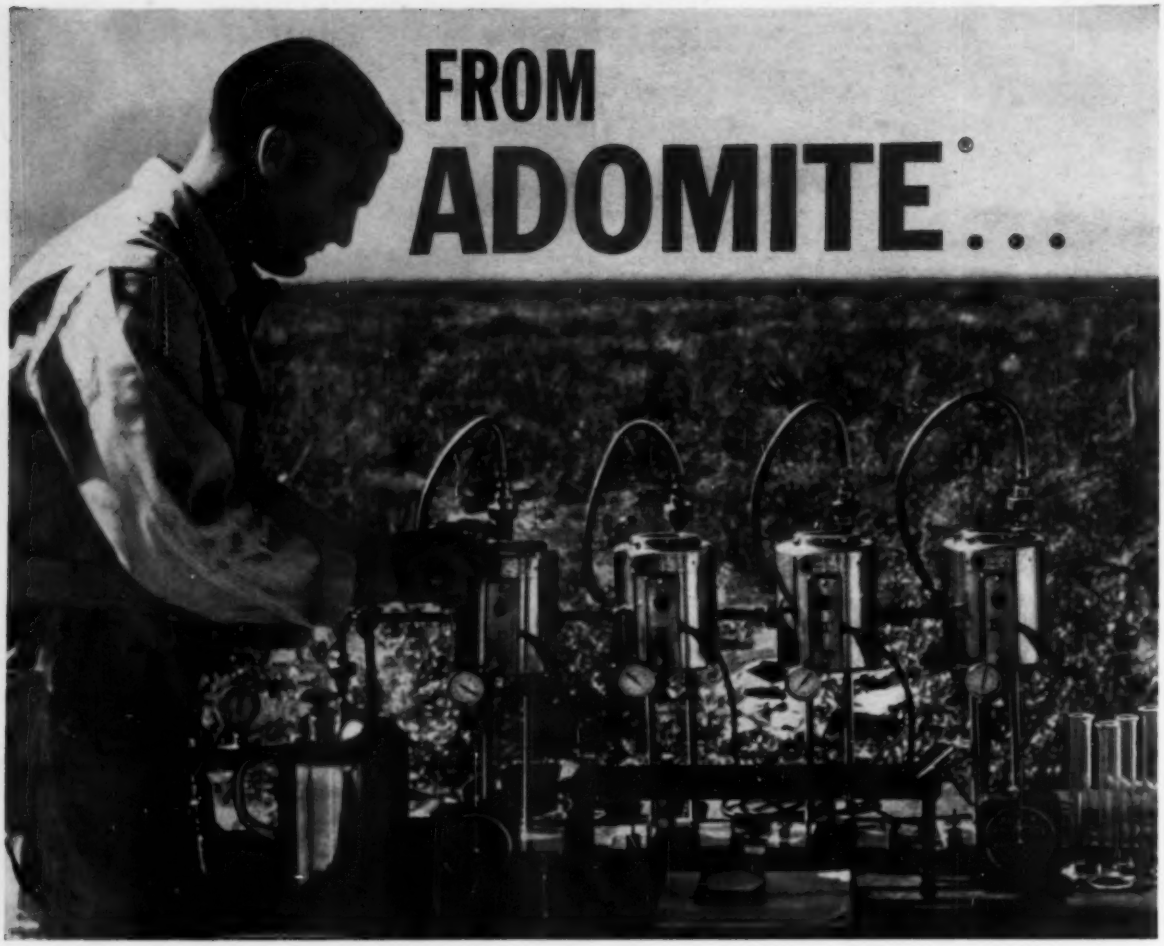
"As I said, it's hard to praise just one segment of the industry, but one thing is certain, all our jobs have been made easier and better because of the companies and men who give the service."

J. L. LATIMER,
President,
Magnolia Petroleum Company

P.E.S.A.

*
PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

PROUD TO BE PART OF A PIONEERING INDUSTRY



the on-the-surface solution to an underground problem

ADOMITE, famous for fluid-loss control, offers producers a special testing service to provide technical assistance and important data on fracturing fluids. Each ADOMITE representative is equipped to run high-pressure, controlled temperature fluid-loss tests at no cost to you.

The job of the ADOMITE man is to provide the best possible fluid-loss control in fracturing fluids. This assures you of the greatest possible fracture extension at the most economical cost.

To find out more about this service and ADOMITE, contact the ADOMITE man in your area. His job is serving you . . . better.

© 1959, Continental Oil Company

R. T. Means
P. O. Box 431
Midland, Texas
MUtual 4-7411

R. W. Hughes
Oklahoma City, Okla.
CEntral 2-1371

Joe M. Foster
Wichita Falls, Texas
Phone 723-8161

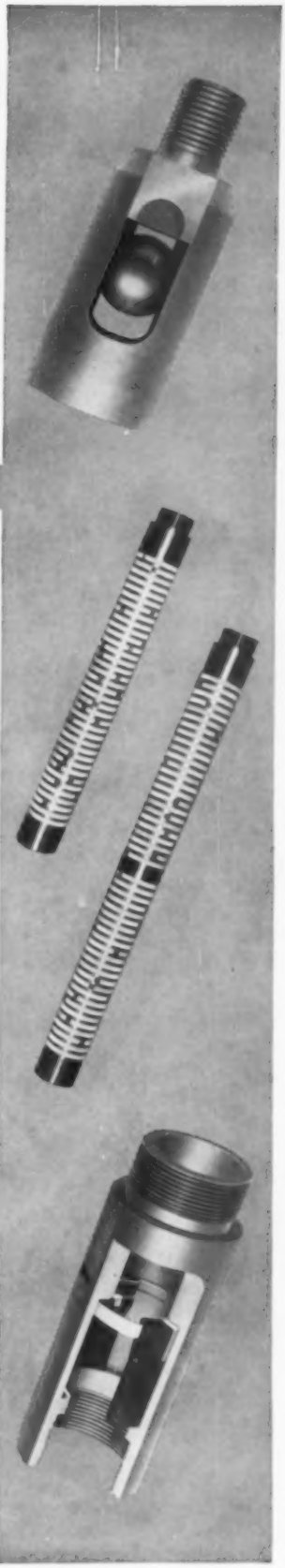
H. L. Thomason
Casper, Wyoming
Phone 3-3721

Goss Yeager
Lubbock, Texas
POrter 3-9271
Borger, Texas
BRoadway 3-5653

ADOMITE

. . . fluid-loss additive

Getting **Value Received** is a prime requirement in your efforts to REDUCE LIFTING COSTS. Giving value received has always been our prime objective.



THE MARTIN PLUNGER is valuable to you because it can be used over and over by replacing only the rings — **plus** the bonus of longer tube life, due to slower wearing action of the resilient rings.

THE MARTIN RUBBER GUIDE CAGES are valuable to you because of their remarkable lasting qualities — **plus** the bonus of improved Ball & Seat life.

"Worth their weight in Gold" would not be an exaggeration, in some cases of extreme savings with these products.

IMMEDIATELY AVAILABLE . . . in all sizes and styles from our Tulsa plant. Sold by all supply companies and stocked at many points. Fully detailed in Composite Catalog, except for recent improvements mentioned below.

The Plungers illustrated are our new standardized 1½ ft. and 2 ft. lengths which screw together to make longer (Box & Pin, cage thread) plungers. You meet many requirements with just a few pieces. Readily interchangeable.

"Extra Clearance" cage guides are now available to give extra ball clearance for large foreign particles, such as Frac Sand, Gyp particles, scale and for viscous fluids. Readily interchangeable or replaced.

JOHN N. MARTIN

Manufacturer

9 W. BRADY STREET • TULSA, OKLAHOMA

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

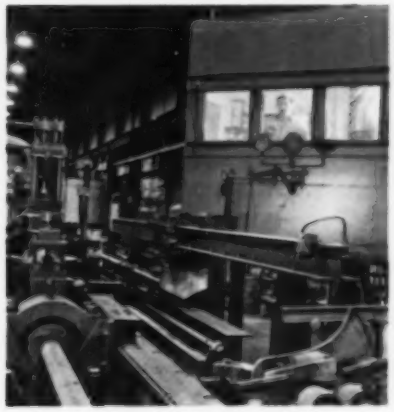
J&L EXTREME LINE CASING permits running rates up to 50% faster. High quality of every length is due to J&L controlled-quality steel, accurate heat treatment, joint design, precision methods of manufacture, inspection and testing. Manufactured under license from the National Supply Co.

Drilling operations have proved the value of J&L Extreme Line casing at this North Dakota well.

This high strength Extreme Line casing is 5½ inch O.D., 17 lb. per ft., Grade N-80.

Integral joint of this J&L Extreme Line casing gives smoother running.

Precision tooling and careful inspection of Extreme Line casing joints hold tolerances within closely specified limits.



This hydrostatic tester is typical of thorough testing equipment used to inspect every length of J&L Extreme Line casing.

High-Pressure, Deep Well Drilling Demands J&L Extreme Line Casing

. . . states a large drilling operator in North Dakota

Drilling operators know that high pressures encountered in drilling deep wells call for special quality casing—casing designed for high strength, leak resistance, and fast running. Extreme Line casing, made by Jones & Laughlin, meets these demands.

MAXIMUM JOINT STRENGTH. A modified Acme-type thread assures a strong interlock because it overcomes the tendency of the mating threads to slide out of engagement.

RESISTANCE TO LEAKAGE. The seal consists of a curved surface extending beyond the male threads, and a tapered conical seat beyond the inside end of the female threads. The seal holds even though the pipe body may expand from internal pressure.

HIGH RUNNING SPEED. Running rates into the well are as much as 50% faster than for conventional API T&C casing in the same size and range length. Deeper stabbing reduces the number of turns required for make-up. Less than one turn is necessary from hand-tight to shoulder contact.

Integral joints with upset ends in Extreme Line casing eliminate couplings and reduce the number of threaded connections to one-half that of T&C casing. Specially designed threads minimize hoop stresses by taking tensional loads in shear. The joint has reduced O.D. and is streamlined, internally and externally.

J&L Extreme Line casing is readily available in J-55, N-80 and P-110 grades. Specify J&L Extreme Line for your severe drilling operations. Write for technical data, Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

AERO CREWS NOW AT WORK THROUGHOUT THE WORLD

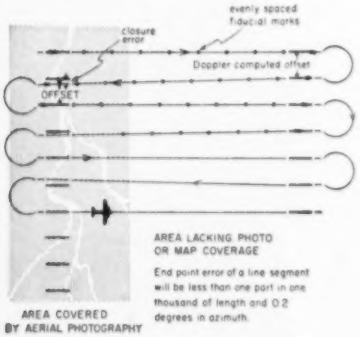
...ready to accept new assignments anywhere

Save for areas behind the Iron Curtain, Aero Service Corporation crews are conducting petroleum surveys in almost every corner of the globe.

One technically dramatic example is the recently completed airborne magnetometer survey covering 30,000 sq. mi. of northern and coastal areas of the Spanish Sahara. The airborne record was completed in one month. Aero will deliver magnetic maps to the Spanish Government this week. These maps will show basement depths and structures. Sixteen participating oil companies will use the maps to help determine their application for exploration rights.

This survey, over previously unmapped, unphotographed terrain, could not have been completed, say Aero geophysicists, without the aid of RADAN® Doppler guidance—the newest navigational aid for airborne exploration.

Other air magnetic surveys for major oil companies are being conducted by Aero crews in Venezuela, Italy, Turkey and Australia, according to Aero's technical staff. At home, Aero is engaged in a joint survey in the Appalachian Basin.


evenly spaced fiducial marks
closure error
Doppler computed offset
OFFSET
AREA LACKING PHOTO OR MAP COVERAGE
End point error of a line segment will be less than one part in one thousand of length and 0.2 degrees in azimuth.
AREA COVERED BY AERIAL PHOTOGRAPHY

DOPPLER guides the survey over faceless terrain, without maps, photos, ground stations. Survey plane is brought to starting point electronically. Pilot flies under guidance of Pilot's Direction Indicator, and the RADAN® computer automatically signals the end of the line. Doppler navigator guides the turn electronically. Offset is automatically recorded, computed and corrected.

Aero's DC-3 at advance base for 40,000 mile Doppler-guided survey.

Still other Aero crews are sighting in on mineral targets in Korea and Thailand, using Piper Apaches for excellent, low-cost "work horse" coverage. In the Middle East, Aero's available aircraft includes the B-17, which has photographed over one million square miles from altitudes of 30,000 ft.

PIPER APACHE: Low cost exploration "work horse".

Aero representatives will be at Booth 627 at the World Petroleum Congress Show to provide complete information on the experience and capabilities of these Aero crews. They are ready to accept new contracts anywhere. Find out how these "on location" teams can cut mobilization costs for your overseas project.

The company's complete services include airborne magnetometer surveys, geophysical interpretation, aerial photography, photo interpretation, photo mosaics, relief models, and topographic mapping. It employs RADAN®, Shoran, Lorac and Raydist plane positioning systems.

AERO SERVICE CORPORATION

Oldest Flying Corporation in the World

Philadelphia 20, Pa.

Shop your nearby SUPPLY STORE

It's well stocked with quality AMERICAN IRON Oil Field Equipment

You'll also find a complete stock of other drilling and producing equipment. Your Supply Store has this equipment ready for you, when and where you need it. They are at your service 24 hours a day, seven days a week.

Get the economical habit of shopping and buying at your Supply Store. And while you're there, check the large stock of quality AMERICAN IRON drilling and producing equipment. This is the equipment you can be sure will help you operate profitably.

SPECIFY AMERICAN IRON

Available through your Supply Store

Another AMF Product
PETROLEUM EQUIPMENT

AMERICAN IRON & MACHINE WORKS COMPANY, INC.
518 North Indiana Avenue • Oklahoma City, Oklahoma
Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

36 Years' Experience in Designing and Manufacturing Oil Field Equipment.

AMERICAN IRON & MACHINE WORKS CO. INC. • OKLAHOMA CITY •

to saturate the porosity in the vicinity of the well bore; otherwise, the instantaneous shutdown pressure will be low.)

(b) The surface injection pressure can be determined from any previous treatment by the instantaneous shutdown pressure at the end of the treatment. If the surface injection pressure is available for a fluid and/or sand concentration different from that to be used on the treatment being designed, this pressure should be corrected for the corresponding difference in hydrostatic heads. Fig. 4 is included to facilitate this operation. For example:

Depth	= 5000 ft
Treating fluid	= Refined oil w/2 lb sand/gal ($\rho = 1.055$)
Surface injection pressure from previous treatment	= 3150 psi w/lease oil ($\rho = 0.86$)
Hydrostatic head lease oil	= 1860 (372 psi/1000 ft × 5)
Hydrostatic head frac fluid	= 2285 (457 psi/1000 ft × 5)
Corrected surface injection pressure	= 2725 psi (3150 psi + hydrostatic head lease oil − hydrostatic head frac)

Hence, under the prevailing conditions, the surface injection pressure of this well with the specified frac fluid is 2725 psi at zero bbl per min.

(c) If the above methods are for any reason impractical, the surface injection pressure of an offset or nearby well could be used. In this event part of the accuracy of the method would be sacrificed.

(d) If none of the other methods can be used, the surface injection pressure may be determined from curves similar to Fig. 5. (Read the bottom hole injection pressure and subtract the hydrostatic head to obtain the surface injection pressure.)

Step 3. Plot the 2725 psi on the selected horsepower chart (Fig. 6). The point would be located on the surface treating pressure scale at "0" injection rate.

Step 4. Next, determine the friction pressure that would be developed at various flow rates with the fluid in question. For example, consider the following:

Depth — 5000 psi
Casing — 5½ in.
Frac fluid — Refined oil with 2 lb sand/gal

From the friction curve for 5½-in. casing (Fig. 7) the friction values would be:

10 bpm — 210 psi (42 psi/1000 ft × 5)
20 bpm — 725 psi (145 psi/1000 ft × 5)
30 bpm — 1475 psi
40 bpm — 2400 psi
50 bpm — 3475 psi

At each rate, add the friction pressure to 2725 and plot the point. Refer to Fig. 6. The five points would appear as follows:

10 bpm — 2935 psi (2725 plus 210)
20 bpm — 3450 psi (2725 plus 725)
30 bpm — 4200 psi (2725 plus 1475)
40 bpm — 5125 psi (2725 plus 2400)
50 bpm — 6200 psi (2725 plus 3475)

Step 5. Now connect the pressure values plotted. At this point, note what information can be derived from Fig. 6. For example, if an injection rate of 33 bbl per min is desired, it would require eight 600-bhp pumps. The well will treat at 4430 psi surface pressure. (If the treatment is not designed for ball sealers, the chart is complete. If ball sealers are to be used, continue with Step 6.)

Step 6. Refer to the graph illustrating perforation injection rates vs. pressure (Fig. 8) and plot the differential pressures above the line calculated in Step 4. For example, at ½ bbl

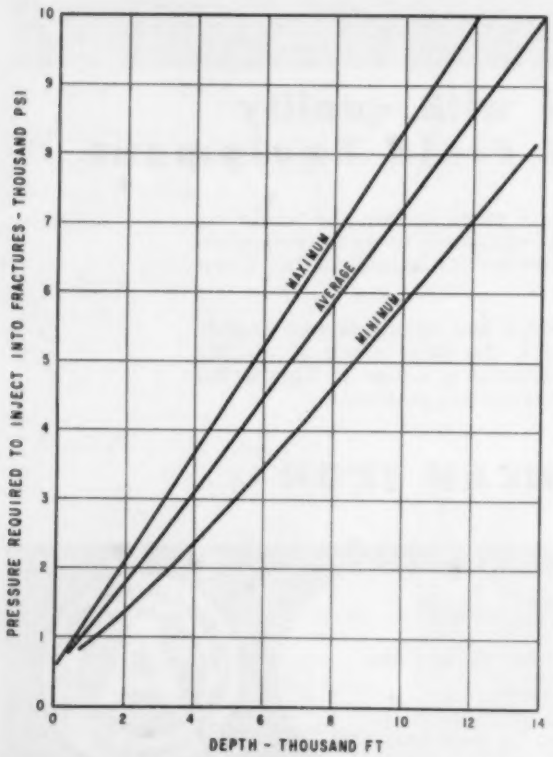


FIG. 5. **Bottom-hole pressures** required to inject fluids into fractures as observed during treatment of 385 wells.

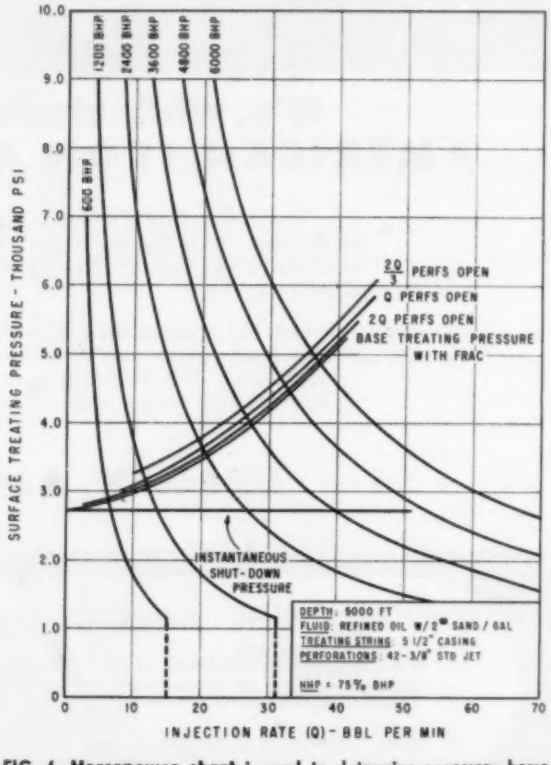
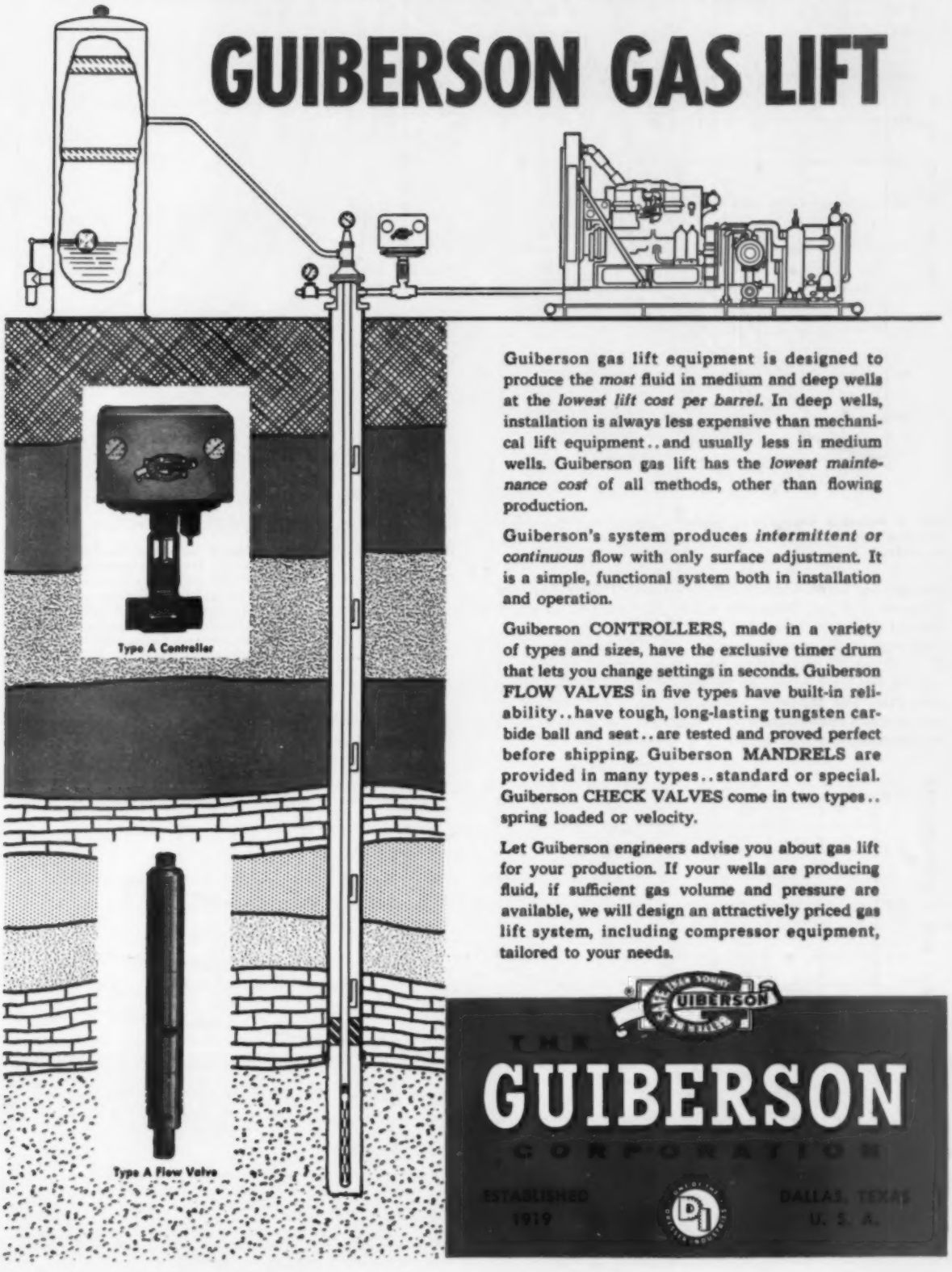


FIG. 6. **Horsepower chart** is used to determine necessary horsepower required to achieve desired injection rate. Corresponding surface treating pressures are also determined from this chart.

When Flow Is Slow.. It's Time For

GUIBERSON GAS LIFT



Guiberson gas lift equipment is designed to produce the *most* fluid in medium and deep wells at the *lowest lift cost per barrel.* In deep wells, installation is always less expensive than mechanical lift equipment.. and usually less in medium wells. Guiberson gas lift has the *lowest maintenance cost* of all methods, other than flowing production.

Guiberson's system produces *intermittent or continuous* flow with only surface adjustment. It is a simple, functional system both in installation and operation.

Guiberson **CONTROLLERS**, made in a variety of types and sizes, have the exclusive timer drum that lets you change settings in seconds. Guiberson **FLOW VALVES** in five types have built-in reliability.. have tough, long-lasting tungsten carbide ball and seat.. are tested and proved perfect before shipping. Guiberson **MANDRELS** are provided in many types.. standard or special. Guiberson **CHECK VALVES** come in two types.. spring loaded or velocity.

Let Guiberson engineers advise you about gas lift for your production. If your wells are producing fluid, if sufficient gas volume and pressure are available, we will design an attractively priced gas lift system, including compressor equipment, tailored to your needs.

THE

GUIBERSON

CORPORATION

ESTABLISHED 1919 — DALLAS, TEXAS U. S. A.

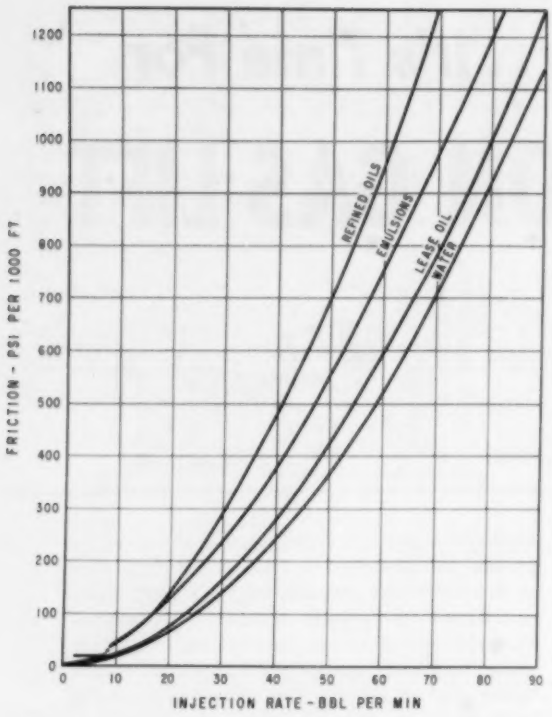


FIG. 7. **Pressure drop** due to friction is plotted as a function of injection rate for refined oils, emulsions, lease oil, and water in 5½-in. casing.

per min per perforation (0.375-in. standard) the differential pressure is 50 psi. This curve will be 50 psi above the curve plotted in Step 4. Note that at ½ bbl per min per perforation and at an overall injection rate Q, there would be Q ÷ ½, or 2Q perforations open. Any rate per perforation can be similarly related to the instantaneous surface injection rate. The following discussion relates the number of perforations open to the overall injection rate because, prior to the treatment, the actual Q is unknown. Also in many cases the amount of BHP available is altered, for one reason or another, during the treatment.

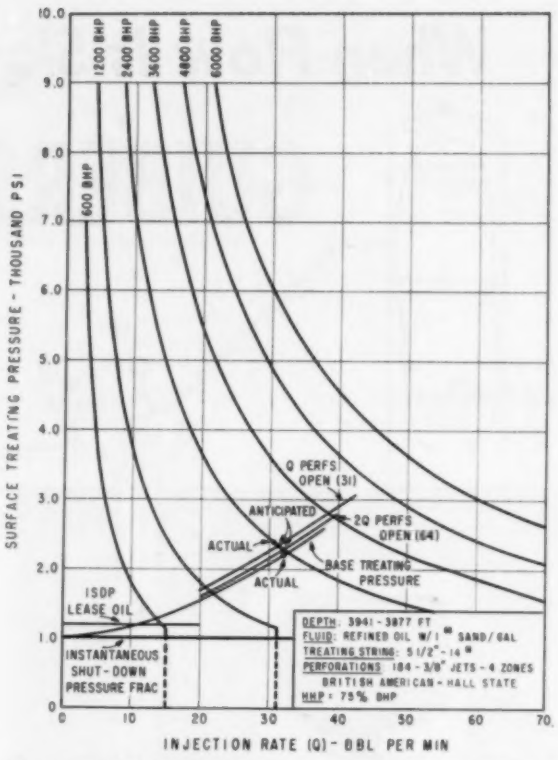


FIG. 9. **Typical treatment design** for actual fracture treatment shows actual and anticipated results. Treatment procedure was: (1) Took first-stage fracture fluid at 2200 psi; (2) Injected 63 balls; (3) Took second-stage fracture fluid at 2250 psi, indicating approximately 64 perforations open; (4) Injected 62 balls; (5) Took third-stage fracture fluid at 2375 psi, indicating approximately 31 perforations open; (6) Injected 30 balls; (7) Took fourth-stage fracture fluid at 2400 psi, indicating approximately 30 perforations open; (8) Treatment concluded since, out of 184 perforations shot, approximately 155 had been sealed and approximately 30 perforations were taking fluid.

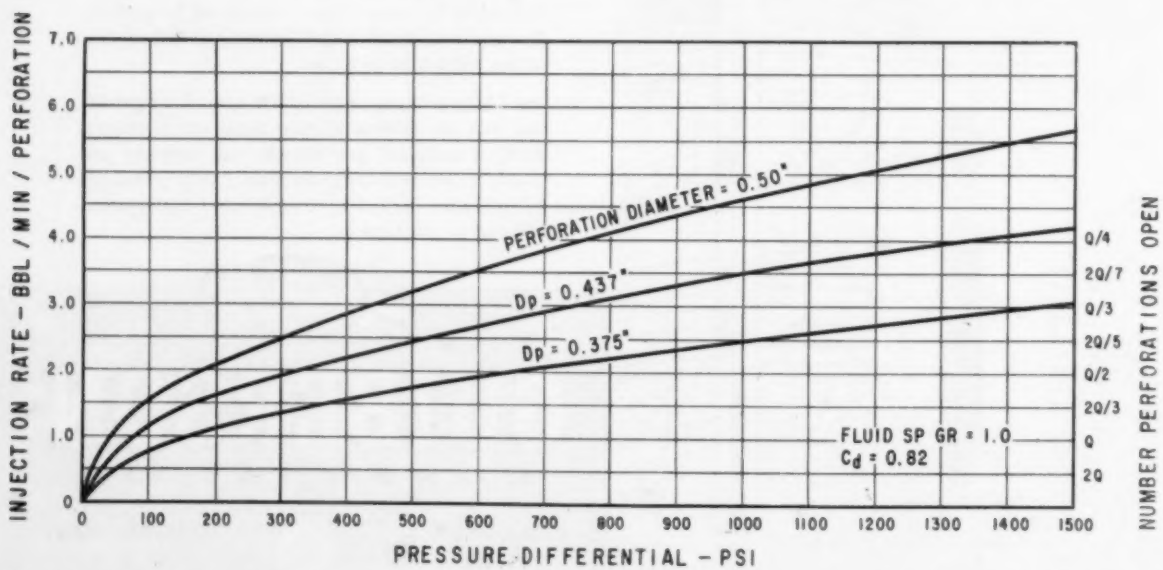


FIG. 8. **Graph of injection rate** through perforations versus pressure differential for 0.375-in., 0.437-in., and 0.50-in. perforations. The graph is calculated for a fluid with specific gravity of 1.0, and for perforations with orifice coefficient of 0.82.

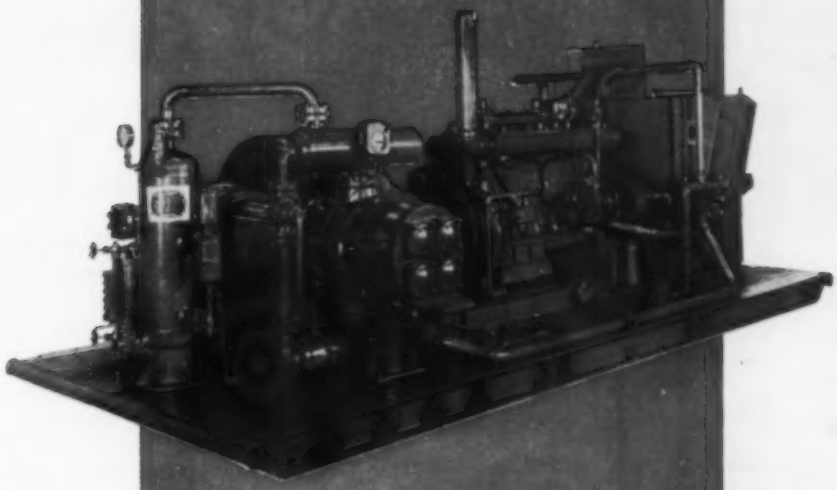
THE

INGERSOLL-RAND

CONTROLLED CLEARANCE

"LINER TYPE" LOW STAGE

COMPRESSOR CYLINDER



MEANS A

"MORE FLEXIBLE"

WILSON SUPPLY — INGERSOLL-RAND

PACKAGED COMPRESSOR UNIT

With "controlled clearance" this cylinder is capable of handling any application where the discharge pressure is between 150 lbs. and 500 lbs. It is necessary only to change liners and/or clearance.

This new cylinder gives sustained high efficiency and trouble-free performance through the use of Ingersoll-Rand Type "A" channel valves.

"WHAT YOU WANT—WHEN YOU WANT IT"

MAIN OFFICE and WAREHOUSE — 1301 CONTI ST.

INTERNATIONAL DIVISION
45 ROCKEFELLER PLAZA, ROOM 1701, NEW YORK

BRANCH STORES

TEXAS: Alice, Corpus Christi, San Antonio, Victoria, McAllen, Bay City, Columbus; Barbers Hill, Liberty, Beaumont, Kilgore, Odessa, Monahans, Post. LOUISIANA: Lake Charles, New Iberia, Houma, Harvey, Shreveport. NEW MEXICO: Hobbs.

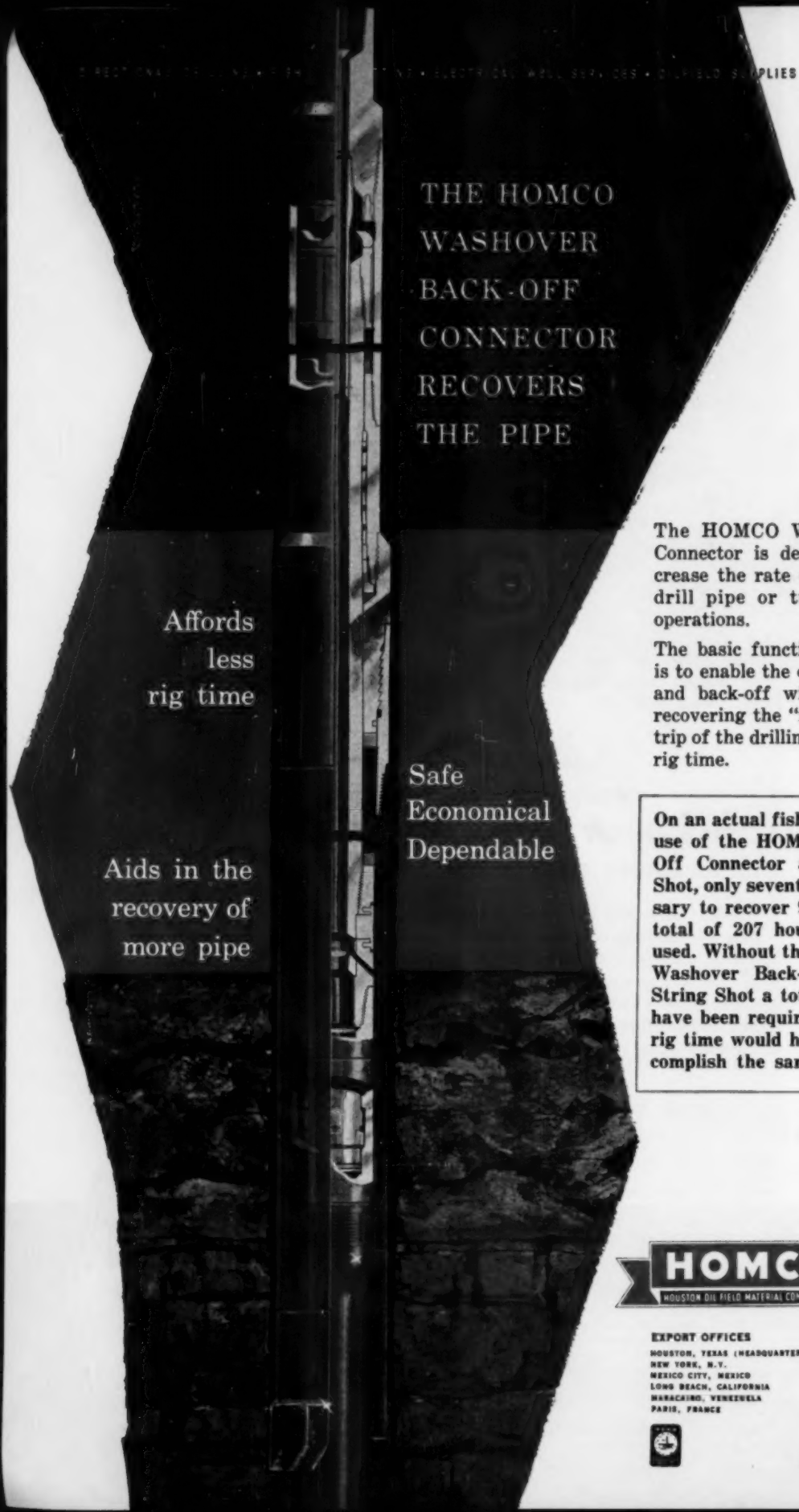
SALES OFFICES

DALLAS	SHREVEPORT	SAN ANTONIO
TULSA	NEW ORLEANS	LAKE CHARLES
MIDLAND	LAFAYETTE	CORPUS CHRISTI
	FORT WORTH	

PESA
PARTNERS IN PETROLEUM PROGRESS

WILSON SUPPLY CO

HOUSTON, TEXAS



THE HOMCO WASHOVER BACK-OFF CONNECTOR RECOVERS THE PIPE

Affords less rig time

Aids in the recovery of more pipe

Safe Economical Dependable

HOMCO

Fishing, Cutting and Electrical Well Service

The HOMCO Washover Back-Off Connector is designed to safely increase the rate of recovery of stuck drill pipe or tubing in washover operations.

The basic function of the connector is to enable the operator to washover and back-off with the string shot, recovering the "fish" with one round trip of the drilling string, thus saving rig time.

On an actual fishing job, through the use of the HOMCO Washover Back-Off Connector and HOMCO String Shot, only seventeen trips were necessary to recover 9,188 feet of pipe. A total of 207 hours of rig time was used. Without the use of the HOMCO Washover Back-Off Connector and String Shot a total of 34 trips would have been required and 412 hours of rig time would have been used to accomplish the same job.

research
engineering
development
manufacturing

HOMCO
HOUSTON OIL FIELD MATERIAL COMPANY

WORLD'S LARGEST INDEPENDENT OILFIELD SUPPLY AND SERVICE ORGANIZATION

EXPORT OFFICES
HOUSTON, TEXAS (HEADQUARTERS)
NEW YORK, N.Y.
MEXICO CITY, MEXICO
LONG BEACH, CALIFORNIA
MARACAIBO, VENEZUELA
PARIS, FRANCE

WRITE FOR TECHNICAL BULLETIN NO. 27-1-1

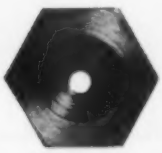
Just A TWIST Of The Wrist With...

GULFCO'S TYPE AB CHOKE

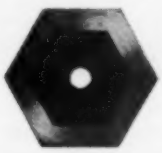
Now, new from Gulfco, a choke that features maximum compactness, maximum simplicity, and maximum interchangeability—from an adjustable Type AB to a positive Type RB as easy as a twist of the wrist. Solve flow control problems with this quality-controlled precision product engineered by Gulfco.

Pinpoint Accuracy

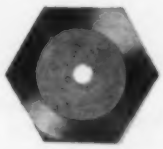
The Gulfco Type AB choke provides maximum control on fractional flow settings with Gulfco's Index Dial. This Gulfco engineered dial gives extremely accurate readings by the use of an index slot which shows only a single figure at a time in the complete range from the fully closed position to full open (48/64").



POSITIVE INSERT



PRORATION INSERT



CERAMIC INSERT

These three inserts can be interchanged in the positive Type RB choke according to need.

GULF COAST MACHINE & SUPPLY CO. GULFCO TRADE MARK PRODUCT BEAUMONT, TEXAS

Go With GULFCO In '59

SEE THE RB CHOKE ON DISPLAY IN OUR BOOTH AT THE INTERNATIONAL PETROLEUM EXPOSITION — TULSA, OKLAHOMA — MAY 14 THROUGH 23.

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

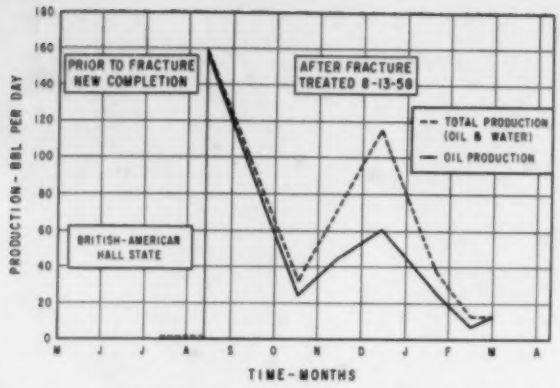


FIG. 10. **Production history** before and after fracture of well treated according to procedure illustrated in Fig. 9.

For a curve indicating perforations taking ½ bbl per min, the pressure values are as follows:

10 bpm — 2985 psi (2935 plus 50)
20 bpm — 3500 psi (3450 plus 50)
30 bpm — 4250 psi (4200 plus 50)
40 bpm — 5175 psi (5125 plus 50)

Connect the points and label the curve "2Q perforations open." Now repeat for one bbl per min per perforation (Q perforations open). From the chart (Fig. 8) note that the required pressure differential is 160 psi. These pressure readings are:

10 bpm — 3095 psi (2935 plus 160)
20 bpm — 3610 psi
30 bpm — 4360 psi
40 bpm — 5285 psi

Connect the points and label "Q perforations open." Repeat the process for 1½ bbl per min per perforation (2Q/3). From the chart you will note that the pressure differential is 360 psi; therefore, this curve will be 360 psi above the base curve.

Continue this procedure until the maximum desired or anticipated pressure buildup through the perforations is plotted.

In order to recognize the meaning of the curves, consider the following:

Surface injection pressure = 2725 psi
Depth . . . . . = 5000 ft
Fluid . . . . . = Refined oil—2 lb sand/gal
Perforations . . . . = 42 — ⅜ in. std. Jet
Casing . . . . . = 5½ in.
BHP . . . . . = 1200

The well is treating at 3000 psi by the surface gage. From the treatment design curve, note that the injection rate is about 12 bbl per min. The well is treating on the "2Q perforations open" curve; therefore, inject 24 balls (neglecting efficiency). After the balls have "hit," the pressure increases to 3150 psi. From the chart, note that the injection rate is now 11.5 bbl per min and the well is treating on the Q curve. Inject 11 or 12 balls. The new treating pressure should be about 3300 psi, indicating that 6 or 7 holes are open and taking fluid. Since only 7 perforations remain in the pipe, no additional balls should be injected.

In the foregoing example, pressure increases are noted that correspond to a point of intersection of the "perforations open curve" and the BHP curve. Such is not always the case; however, the number of perforations open versus the pressure increase is essentially linear between any two "perforations open" curves. In view of this, it is possible to interpolate any point between any two "perforations open curves." The 600-BHP curves are plotted in multiples of two. In the event that an odd multiple of 600 BHP (or fractional) is desired, these curves may also be interpolated. In order to facilitate the use of odd multiples of 600, a curve for 600 BHP is included.

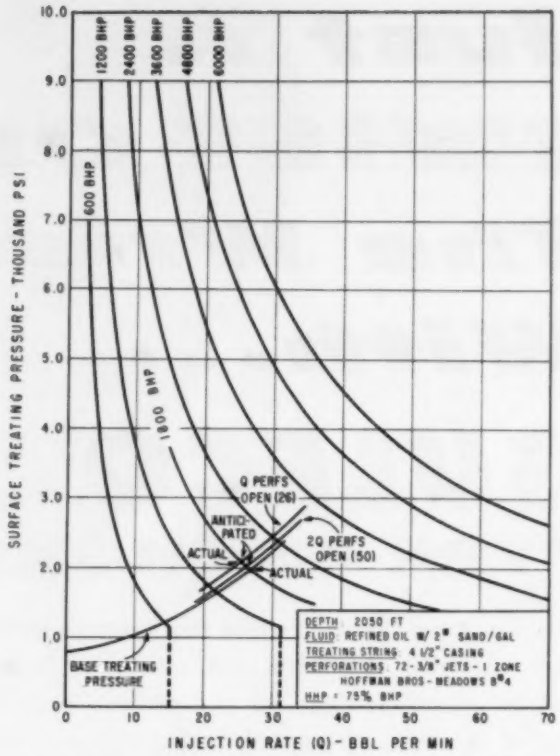


FIG. 11. **Treatment procedure** in 4½-in. casing was: (1) Well took first-stage fracture fluid at 2000 psi, indicating that approximately 54 perforations were taking fluid. Since there were only 72 perforations in the casing and only a minimum restriction was desired, 40 balls were injected; (2) Well took second-stage fracture fluid at 2150 psi, indicating that 26 perforations were taking fluid. (Treating pressure hit 2200 psi but broke back to 2150 psi.); (3) Treatment concluded. (Of the 72 perforations in casing, 40 were sealed and 26 were taking fluid during second stage of fracture, leaving a maximum of 6 perforations that had not been broken down and treated. Since a single, continuous zone was perforated, no attempt was made to break the remaining 6 perforations.)

Previous production — new completion. Date treated — 9-8-58. Production after treatment — flowing (to 3-23-59) 52 bbl of oil per day (allowable). Offset production — flowing allowable. (The offset was treated using this design procedure.)

Results

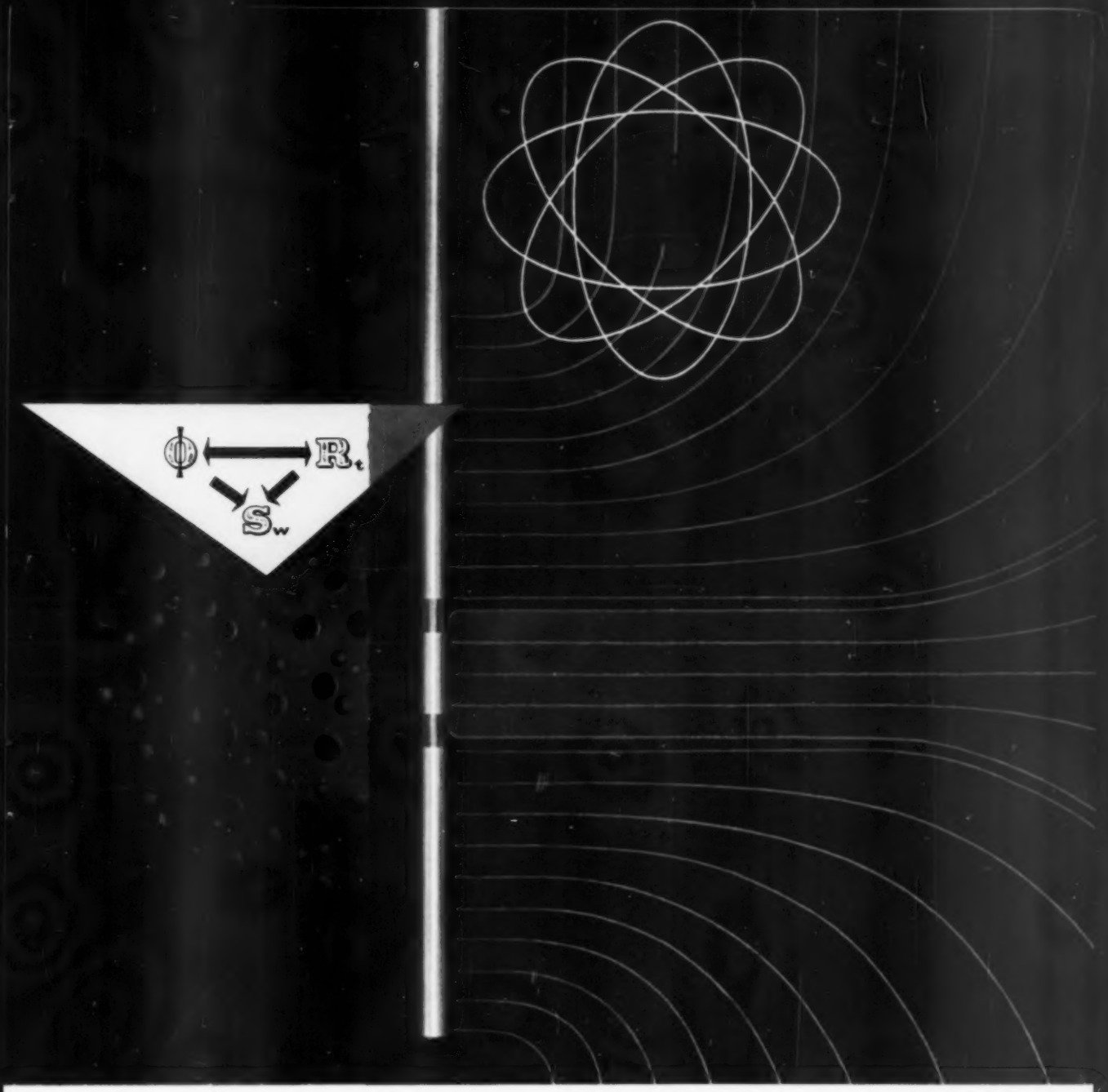
On 35 treatments that the authors have designed only three "disappointments" resulted. On one of these three, two (or more) zones communicated. On the other two the wells treated at higher pressures than could have been expected and the design curves were low. On each of these treatments, the difference was uniform throughout, indicating that some unknown well condition increased the injection pressure into the formation.

As a rule, the wells treated using the ball sealer treatment design procedure produced superior wells. Fig. 9, 10, 11, and 12 depict typical designed treatments and the resulting production data.

Conclusions

The production results and field data (Fig. 9, 10, 11, and 12) indicate that the engineering design procedure may be

(Continued on Page B-108)



The NEW Schlumberger Laterolog-Gamma Ray-Neutron Combination
simultaneous recording saves hours of rig time

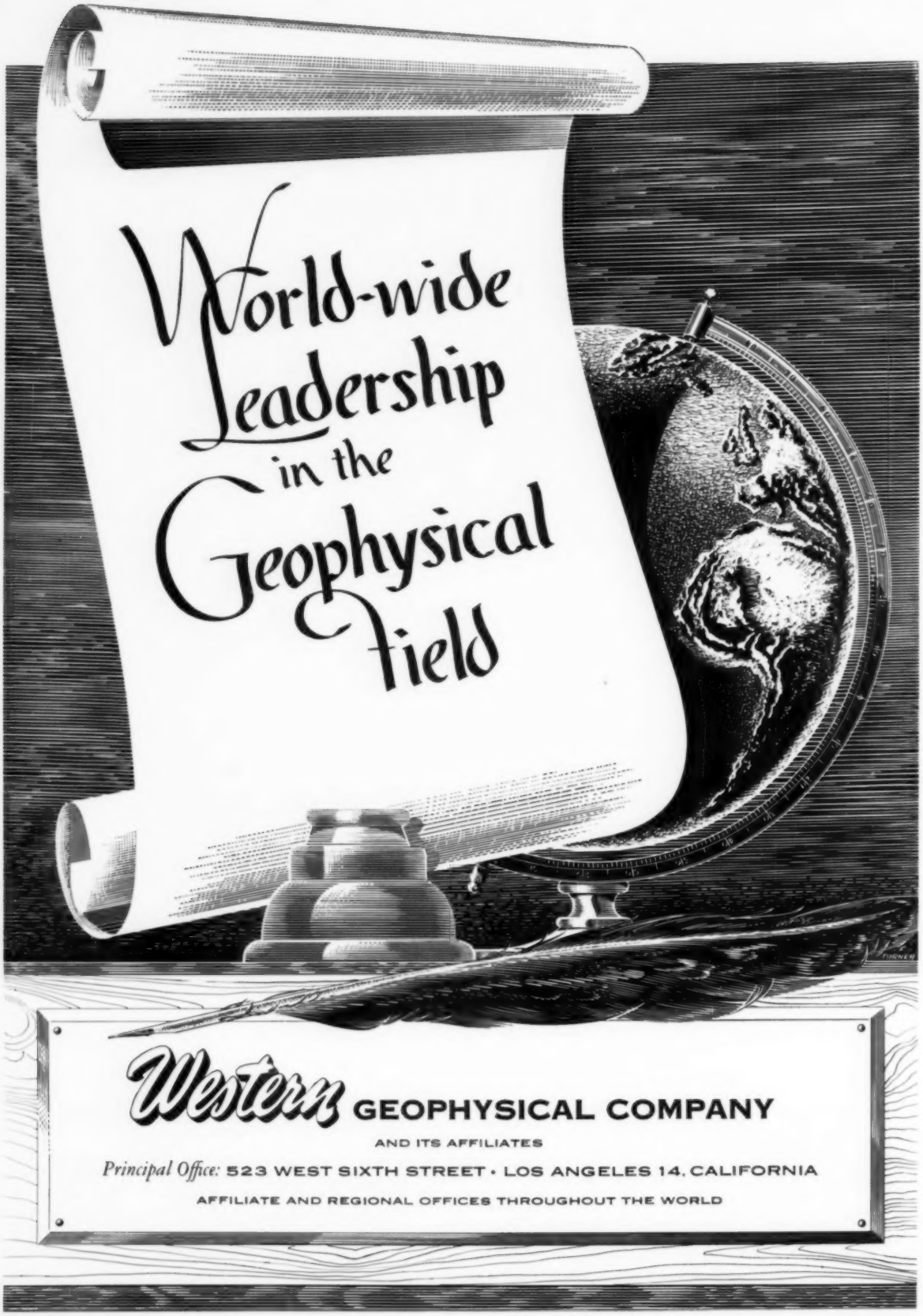
Here is another logging *first* by Schlumberger, engineered to give you these extra benefits:

- *Simultaneous Recording* — a single trip, a single film.
- *Highly Sensitive Gamma Ray-Neutron*—the newest transistorized Schlumberger radioactivity logging instrument.
- *Electronically Focused Laterolog* — confines measurement to electrode level, records values close to true resistivity.
- *Better Log Presentation* — interesting sections stand out at a glance.

In hard-rock formations, or in salty muds, the New Schlumberger Laterolog-Gamma Ray-Neutron Combination gives superior results with greater efficiency. Ask your Schlumberger engineer for details. It will cost you less to use the best!

THE EYES OF THE OIL INDUSTRY®

SCHLUMBERGER



Western GEOPHYSICAL COMPANY

AND ITS AFFILIATES

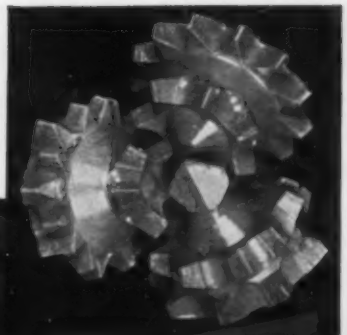
Principal Office: 523 WEST SIXTH STREET • LOS ANGELES 14, CALIFORNIA

AFFILIATE AND REGIONAL OFFICES THROUGHOUT THE WORLD

FORMATION RATINGS: For soft shales, salt, red beds, and others having low compressive strength.

SIZES: 27 bit sizes from 5⅝ inches to 15 inches

S3

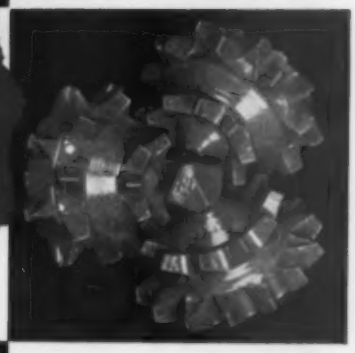


FORMATION RATINGS: For soft to medium formations . . . firm sandy shale, etc.

SIZES: 23 bit sizes from 5⅝ inches to 12¼ inches

S4

SECURITY makes the RIGHT BIT for the job!



S6

FORMATION RATINGS: For soft medium to medium formations . . . medium shales, gypsum, salt, chalk, anhydrite, medium hard limestone, and broken or semi-consolidated formations.

SIZES: 27 bit sizes from 5⅝ inches to 15 inches

For Soft Formation (and all) drilling . . specify SECURITY Bits*

Security makes a *complete line* of rock bits, 1120 types, sizes, and variations — 344 made exclusively for SOFT FORMATION drilling.

Like all Security bits, Security's three *soft formation* classifications — the S3, S4, and S6 — are offered in regular, jet, air, or jet-air circulation. Complete specifications are detailed in Security's 1959 catalog, yours for the asking.

Choosing the RIGHT Security bit assures fastest penetration, maximum footage — greatest drilling economy. Specify Security and get the RIGHT bits for every well you drill.

***344 TYPES, SIZES, and VARIATIONS**

Security

PLANTS: Odessa, Texas; Wichita, California; Henderson, England . . . SECURITY ENGINEERING DIVISION, 3400 W. Illinois, Dallas, Texas . . . REPORT OFFICE: P. O. Box 1347, Dallas, Texas . . . CANADA: Security Engineering Canada, Ltd., Edmonton, Alberta, Canada . . . W. HEMISPHERE: Security International C.A., Caracas, Venezuela . . . E. HEMISPHERE: Security International C.A., London, England

Available through your favorite Authorized Supply Store

For long-stroke units . . .

Now a Two-Piece "Transportable" Rod Pump for Deep-Well Pumping

Here's a special long-stroke rod pump that's easily *carryable* to the lease. The H-F Transportable Rod Pump is designed for either hydraulic or beam unit pumping of deep wells. The barrel tube and pull rod, precision-machined and matched for an exact realignment, are broken apart and carried in two sections on the side of a car, then assembled for running in the well.

The pump is installed with a bottom lock hold-down in a standard lower seating shoe. A cup-type top hold-down seats in an upper shoe to stabilize the pump during operation. The upper hold-down also seals off the pump-tubing annulus from sand accumulation at the hold-down. The entire pump is strong and tough — sufficiently rugged to produce efficiently in deep wells.

The H-F Transportable Rod Pump, equipped with an 81-ring Flexite® Plunger, is available in 2″ x 1¼″, 2½″ x 1½″, and 2½″ x 1¾″ sizes, with a 32′ or 38′ plunger stroke.

If you want to run a dependable rod pump — and get it out to the well at the very moment you're ready to run it — ask one of our factory representatives about this special new pump. Also ask the Harbison-Fischer man, your store, or write us at Box 127 for an illustrated bulletin, without obligation.

H-F WIDE DESIGN 'FLEXITE'® RINGS have three times the sealing surface of regular rings, but only twice the length...ideal for deep-well pumping.

HARBISON-FISCHER MFG. CO., Fort Worth

REPRESENTATIVES IN ALL MAJOR PRODUCING AREAS

"Best Pumps in the Oil Patch"®

Pacific Coast API 'Explores Space'

Almost 1300 attended the 32nd annual meeting of the Pacific Coast District of the API Division of Production, April 30 - May 1, in Los Angeles.

More than two dozen technical papers and discussions were heard in the two-day meeting, in addition to the featured addresses by Dr. William L. Pickering and Robert L. Minckler.

Five district men were honored with API "Citations for Service" at the annual banquet April 30. Recipients this year are John E. Orrell, Shell Oil Company, Los Angeles; Ray A. Malott, Shell Oil Company, Los Angeles; Ray Elner, Kobe, Inc., Los Angeles; Harry D. Aggers, Union Oil Company of California, Los Angeles, and James T. Carriel, Signal Oil & Gas Company, Los Angeles. The Citations were presented by L. E. Fitzjarrald, manager of the production department, Phillips Petroleum Company, Bartlesville, Oklahoma, and API vice president for production.

Dr. Pickering, director of the jet propulsion laboratory at California Institute of Technology, Pasadena, was principal speaker at the banquet session, speaking on "The Exploration of Space."

Minckler, president of General Petroleum Corporation, Los Angeles, spoke at an opening-day business meeting. His remarks covered the "Challenge to Business Management."

Technical presentations included symposiums or panel discussions of casing cathodic protection, sand control in California, secondary recovery, and possible approaches to reduction of drilling and completion costs in California.

New Officers

The 1959-60 district officers for the Pacific Coast District were elected at the business meeting. The new officers are: H. H. Ewing, Union Oil Company of California, chairman; Paul Hamann, E. B. Bell & Company, vice president, Los Angeles Basin; Kenneth Nugent, McCullough Tool Company, vice chairman, Coastal Area; Don J. Everitts, The Ohio Oil Company, vice chairman, San Joaquin Valley; Leon E. Matthews, Republic Supply Company, vice chairman, Coalinga-Kettleman; C. R. Ball, Ball & Black Supply Company, treasurer; and Mrs. Elsie M. Edmiston, API secretary.

C. F. Gates, General Petroleum Corporation and O. A. Graybeal, Sunray Mid-Continent Oil Company were also elected as chairman and vice chairman, respectively, of the advisory committee.

Development and Evaluation of . . .

Gas-Condensate Reservoirs

***Part 3** of a fundamental series of gas-condensate reservoirs discusses the preparation and importance of proper contracts in both interstate and intrastate gas sales*

William C. Goodson
Republic Natural Gas Company
Dallas, Texas

Gas Contract Considerations

When the field has been developed, tested, and evaluated and found to have considerable reserves, the key factor in the entire appraisal or evaluation becomes apparent. This is the negotiation of the Gas Purchase Contract.

Gas has come a long way from 1945 when it supplied only 12 percent of the energy consumed in this country. Now its share of the energy consumption is over 25 percent, and it is almost equal to coal. In the 30's gas was considered to be a nuisance, and its only sales were distress sales or as a by-product of oil production. With the increased demand and value on natural gas, it behooves both the producing companies and the pipeline companies to utilize their best talent in the formulation of gas purchase contracts. With these thoughts in mind some of the ideas to consider in gas contracts will be discussed.

Interstate Sales

As most readers are aware in interstate sale and transportation of natural gas, both the seller and purchaser are under the control of the Federal Power Commission. In the now-famous Phillips Case decision by the Supreme Court in 1954, the producers of natural gas were made subject to the Natural Gas Act of 1938 and, as a consequence, the producers must have their price approved by the FPC. As one of the five commissioners of the FPC succinctly put it, "We were given this job to do by the Supreme Court, but we were not told how to do it."

The pipelines have been historically subject to regulation by the FPC in interstate movement of gas. Even prior to the Natural Gas Act of 1938 the regulation of interstate transmission of gas had been removed from state public utility commissions. Despite the obvious differences in the utility type operation of pipeline and the risk taking venture of gas producers, the FPC has been attempting for over 4½ years to accomplish the herculean task of attempting to fit natural gas production in the traditional rate base framework.

The price and demand for natural gas have had a steady and sometimes spectacular growth since World War II despite the stifling utility-type control measures placed on production operations in 1954. If anything, the trend in price increase is even steeper since 1954, particularly for new contracts.

Production standpoint. The gas purchase contract from the producers' standpoint is subject to certification by the FPC and the price is subject to the commission's approval. No clear-cut method has been devised in the 4½ year control by the FPC for definite price setting of interstate gas. Some of the approaches or methods that have been used are:

1. Sales realization or cost of service,
2. Btu or energy content,
3. Arms length bargaining.

Recently in the so-called omnibus case, nine independent producers presented a very detailed study of their individual and joint operations. This study was prepared by the Foster Associates. The study related five principal factors which have an influence on the price of gas at the wellhead. These five items are:

1. Date of Contract,
2. Distance from consumers' markets,
3. Volume of reserves dedicated,
4. Term of the Contract,
5. Quality of the gas.

In this particular omnibus study, the price for gas separately found from oil was in the range of 23.0 cents per Mcf to 32.0 cents per Mcf. In this light, this is a similar finding to that of the Carter Oil Company study that found that the cost of replacing oil in Kansas and Oklahoma was now higher than the price received for the oil being produced.

Pipeline standpoint. The pipeline companies, in general, follow this procedure when desiring to expand their facilities. The company files its application with the FPC and proves its ability to finance the desired construction and gives the reserve data to support the supply requirements of this expanded market. Full details of all fields, reserve life, deliverability data, estimated withdrawals reflecting an adequate and ample productive life to support the dockets are presented and testified to by expert technical witnesses.

The FPC zealously guards this right of examining a pipeline's ability to finance and construct additional facilities, and supply additional expanding markets. The pipelines must of necessity contract and have at their disposal the additional gas before presenting their docket to the FPC. In the event of delay or denial by the FPC, the pipelines for a time are in the position of having gas rolling out their ears.

One of the items that in a large measure determines the profitability of transmission operations is the load

(Continued from Page B-102)

factor. Due to the seasonal nature of this business, the summer-time slack must be taken up by interruptible short term industrial contracts. Another method to help overcome this and maintain line capacity is underground storage. This is being constantly investigated by major pipeline companies and is showing a tremendous growth. Underground storage has grown from 70 pools in 11 states with a capacity of 135 billion cu ft in 1947 to 200 pools in 19 states with a capacity of 2603 billion cu ft in early 1957. This is equivalent to a 19-fold growth in 11 years, or an average annual increase in capacity of 31 percent.

Intrastate Sales

As the name implies this is the sale of gas by a producer to a pipeline for ultimate use and consumption within the borders of a given state. With many of the producers, particularly in the Southwest, this is a must. In these negotiations the FPC has no jurisdiction over the operation from the producers' standpoint. This does alleviate tremendous paper work on the part of the producer.

In most cases the intrastate contract does not carry as high a price or require as great a reserve life index as the interstate contract. In many cases, the contract is to supply a large commercial or industrial customer locating a plant in the vicinity of large gas fields.

Considerations Involved in Contract Negotiation

From the foregoing and from many recent articles the importance of contractual considerations cannot be overstressed. To consider all of the points is not within the scope of this problem. However, a list of some of the more important would seem to be in order:

1. Price
   - Possible escalation
   - Favored nations clauses
2. Delivery pressure and provisions for compression below this point
3. Quality
   - Water content (usually 6 lb or 7 lb per MMcf maximum)
   - Sulfur content
   - Btu content (usually 1000 Btu per cu ft minimum before penalty)
4. Processing clause
   - Seller should insist on right to produce gas or participate in its processing
5. Take or pay clause
6. Minimum and maximum daily rates
7. Balancing periods and flexibility
8. In event contract has not spelled out everything or disagreements which cannot be solved mutually arise, arbitration should be provided
9. Life of the contract
10. Area and leases designated in the contract.

The instrument should be closely checked by legal and technical counsel for both the producing company and the transmission company prior to execution of the contract by officers of both companies (usually the executive vice president or president).

Assumed Contract Conditions

A. Interstate Contract at 20 cents per Mcf for 20 years,
B. Interstate Contract at 15 cents per Mcf for 20 years,
C. Intrastate Contract at 10 cents per Mcf for 10 years.

In all three cases it will be assumed that the foregoing considerations apply, except for the fact that the price is to remain constant throughout the specified life. An economic analysis will be made to determine the comparison of the profitability of the three contracts utilizing the reserve data as given in Part 2 of this series.

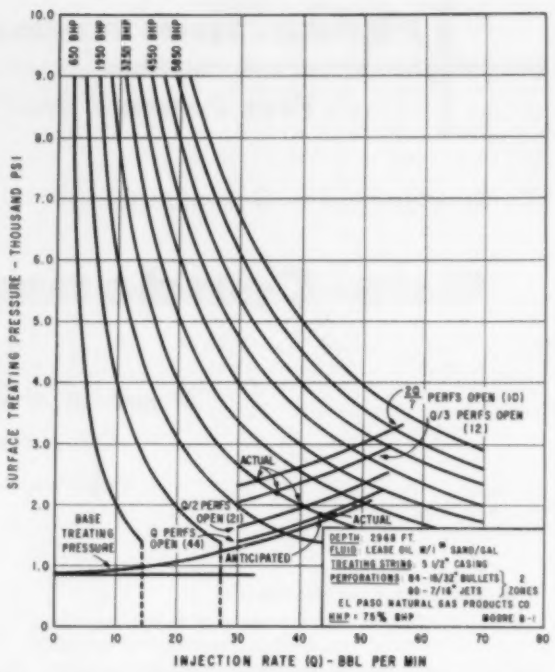


FIG. 12. **Dual-zone treatment** procedure was: (1) Well took first-stage fracture fluid at 1800 psi. This pressure was below the "Q" Perfs Open" curve and about 25 psi above the base curve. This indicated that about 84 perforations were taking fluid; (2) Injected 80 balls; (3) Pressure increased to 2400 psi, indicating that 10 perforations were taking fluid; (4) Injected 12 balls; (5) Pressure increased to 2900 psi and broke back to 2200 psi, indicating that a new zone had broken down and that 12 perforations were taking fluid; (6) Injected 12 balls; (7) Pressure increased to 3000 psi and would not break back. Since 3000 psi was casing maximum, balls were released and treatment was continued at 2000 psi.

Well completed — May 1954. Initial production — 529 bbl of oil per mo. Production Feb. 1957 — 248 bbl of oil per mo. Well treated 12-2-58. Production after treatment — 527 bbl of oil per mo. Production 3-20-59 — 527 bbl of oil per mo.

used to assure a treatment of each perforated zone. A maximum oil production and maximum recovery will result when each perforated zone is individually treated.

The reduction of the number of perforations, the use of ball sealers, and the use of this design procedure will provide a notable economic saving.

Even though the design procedure is not a perfected science, results indicate that through the use of engineering information, treatments can be significantly improved.

Acknowledgment

The authors wish to express their appreciation to the various producing companies that assisted in the collection of data and to The Western Company for permission to publish these findings. They would like to extend special appreciation to El Paso Natural Gas Products Company, British American Oil Producing Company, The Hoffman Brothers' Producing Company, and J. R. Rich for their permission to publish the treatment and production data appearing in Fig. 9, 10, 11, and 12.

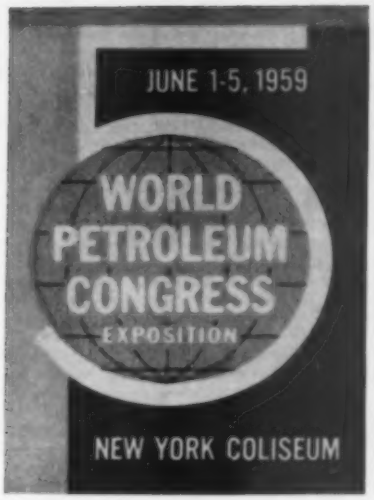
References

1. Neill, George H.; Brown, Robert Wade; and Simmons, Charles M., "An Inexpensive Method of Multiple Fracturing," Paper No. 906-2D presented at Spring Meeting of the Southwestern District A.P.I., Division of Production, March 6 - 9, 1957. (Drilling & Production Practice 1957.)
2. Stekoll, Marion H. "Fracturing Through Perforations," *Oil and Gas Journal*, October 29, 1956.
3. Coburn, Richard W., "Custom-Designed Well Stimulation," *Oil and Gas Journal*, March 4, 1957.
4. Crittendon, Bob C. "The Mechanics of Design and Interpretation of Hydraulic Fracture Treatments," AIME paper Number 1106-6. ★ ★

Here is a list of . . .

DRILLING AND PRODUCING PAPERS SCHEDULED FOR PRESENTATION AT THE

Fifth World Petroleum Congress



NEARLY 300 TECHNICAL PAPERS have been selected for presentation to delegates at the Fifth World Petroleum Congress, meeting in New York, June 1-5, 1959. Of these, 32 papers are included in Section II — Drilling and Producing — and represents several countries. The following list of the drilling and producing papers includes a brief abstract of each paper to be presented.

Paper 1. Economics of Offshore Petroleum Development in the U. S. A.
Bouwe Dykstra, Vice President, Shell Oil Company, New Orleans, Louisiana

It is estimated that ultimate recoveries on the shelf of Texas and Louisiana within reach of present drilling and production methods might be 8.5 billion bbl of oil and 64 trillion cu ft of gas. To reverse the downward trend of operations it will be necessary to lighten the increasing governmental burden and to set higher allowables for offshore wells in deeper waters.

Paper 2. Conservation of Oil and Gas in Texas
General Ernest O. Thompson, Commissioner Texas Railroad Commission, Austin, Texas

Conservation and prevention of waste has progressed through application of sound, fundamental engineering principles such that ultimate recovery of oil has been increased many times over what would have been recovered through improper producing methods.

Paper 3. Progress in the Theory and Practice of Oil and Gas Field Development in the U.S.S.R. (NOTE: Paper withdrawn from Congress.)
A. P. Krylov (et al), Director, All-Union Research Oil and Gas Institute, U.S.S.R.

Paper 4. Oil Shale — Energy for the Future
Fred L. Hartley, Vice President, and Claude S. Brinegar, Supervisor Economics and Planning, Union Oil Company of California, Los Angeles, California

Timing of the creation of a new major segment of the petroleum industry based on oil shale is reduced, essentially, to a question of an appropriate supply-demand balance. Benefits of such ultimate fruition are seen to be substantial.

Paper 5. Some Special Features of Drilling Contracts Outside North America
Th. J. Vrins, N.V. De Bataafsche Petroleum Maatschappij (Royal Dutch/Shell Group), The Hague, Netherlands

The conditions are described which, outside North America, generally call for major provisions not or seldom contained in customary North American drilling contracts, such as duration of overseas contracts, specification of contractor's services and amount of drilling investment, auxiliary services, and special risks.

Paper 6. A Theoretical and Experimental Study of Drill String Stability in Turbodrilling. Its Relationship to Borehole Deviation.
Societe Nationale de Petrole D'Aquitaine & Societe Neyrpic, France
(Abstract not available.)

Paper 7. Progress in Turbodrilling and Study of New Drilling Methods in the U.S.S.R. (NOTE: Paper withdrawn from Congress)
R. A. Ioannesyan (et al), Research Director, All-Union Scientific Research Institute of Drilling Technique, U.S.S.R.

Paper 8. Air and Gas Drilling
L. W. Randerson, Drilling Section Chief, Magnolia Petroleum Company, Dallas, Texas

Studies have indicated that significant savings and a several-fold increase in drilling rates can be effected through the use of air and gas drilling in specific operations; certain other attempts to use the technique have resulted in economic failure.

Paper 9. Shale Controlling Drilling Fluids
Walter J. Weiss, Wilbur L. Hall, and Richard H. Graves, Research Chemists, Research and Technical Department, Exploration and Production Research Division, The Texas Company, Bellaire, Texas

Studies of the surface chemistry of clays has led to a shale control mud system which couples a high filtrate calcium level with a controlled alkalinity environment. Mud systems which have been or are in common usage are compared.

Paper 10. Drilling Problems Encountered in High Pressure Formations in the Po Valley — Possible Use of Bottom-Hole Movers
Cesare Gavotti, Vice Directeur General Agip Mineraria, Milan, Italy

Drilling problems raised by abnormally high pressure conditions in the Po Valley may be solved by drilling with bottom-hole movers. Of these, the turbodrill is the most commonly used.

Paper 11. Drilling and Producing Operations in Lake Maracaibo
Dr. F. G. Baptista, Production Department Manager, Creole Petroleum Corporation, Caracas, Venezuela; Dr. Luis Alcala Sucre, Member of Board of Directors, Mene Grande Oil Company, Caracas, Venezuela; Dr. Jose Dominguez, District Superintendent, La Concepcion, Cia Shell de Venezuela, Maracaibo, Venezuela; and Paul Conrad, Chief Geophysicist, Socony Mobil Oil Company of Venezuela, Caracas, Venezuela

Prolific oil production has been developed along the north-east shore and extended out into Lake Maracaibo for a distance of more than 20 miles. More than 3700 wells have been completed in the lake proper, and maximum production has exceeded 1.4 million bbl per day.

Paper 12. Oil Well Spacing — A Technical and Economic Analysis
A. Landoni, Former Director, and B. L. Astiz, General Manager, Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina

Analysis of oil well spacing is made by determining the minimum spacing in a practical manner, and by establishing the spacing in function of both technical and economic considerations involving total recovery, duration of exploitation, production development, and drilling cost.

Paper 13. Automatic Production Control
W. R. Scrimes, Regional Electrical Engineer, Imperial Oil Limited, Calgary, Alberta, Canada

Cooperation between the producer and the pipeliner has resulted in the development of certain automatic systems which include an automatic battery, a satellite battery, and a modified satellite battery made possible by development of a compact well-tester.

Paper 14. Reservoir Rocks, Fluids and Energy Systems of the Matzen Field in the Vienna Basin
A. Kaufmann, Reservoir Engineer, L. Koelbl, Research Geologist, and H. Kratochvil, Supervisor of the Laboratory of Production Research, Oesterreichische Mineralolverwaltung A. G., Vienna, Aus-

tria; H. Wieseneder, Professor of Petrography at the University of Vienna, Austria

Data on grain-size distribution, porosity, permeability and mineralogical composition of the reservoir rocks of the Vienna Basin are shown graphically. Chemical analyses of oil, gas, and brines and the behavior of reservoir fluids under reservoir conditions are shown.

Paper 15. The Pembina Oil Field, Alberta, Canada — An Example of a Low Permeability Reservoir

L. C. Stevens, Vice President and Manager of Production, S. F. Bird, Assistant Chief Petroleum Engineer, and J. J. Justen, Chief Reservoir Engineer, Mobil Oil of Canada, Ltd., Calgary, Alberta, Canada

The Pembina Field is the largest in Canada and is characterized by a low order of natural rock permeability associated with a thin pay. Presented are the geology, rock characteristics, reservoir fluid characteristics, completion techniques, reservoir performance, and pressure maintenance operations.

Paper 16. Compressibility and Specific Gravity of Formation Brines Under Reservoir Conditions. Applications to Reservoir Engineering Problems

Giordano Long, Chef du Service Geochimique et Laboratoires, and Gian Luigi Chierici, Vice-Chef du Service Geochimique et Laboratoires, AGIP Mineraria, Milan, Italy

Based on experimental data, some formulas have been deduced which allow the calculation of the specific gravity and the isothermal compressibility of brines at the thermodynamic conditions of the reservoir.

Paper 17. Controlled Reservoir Operations — A Case Study

W. J. Greenwald, Chief Reservoir Engineer, and H. H. Meredith, Jr., Division Petroleum Engineer, Humble Oil & Refining Company, Houston, Texas

Under sound reservoir controls and cooperative procedures, recovery from the Pickton reservoir has been increased from an estimated 6,600,000 bbl to an anticipated recovery of more than 20,000,000 bbl.

Paper 18. Continuous Measurement of Bore Hole Formation Dip With the Poteclinometer

J.-M. Bricaud, Directeur des Etudes, and A. Poupon, Chef du Service Interpretation, Societe de Prospection Electrique, Paris, France

In a new dipmeter, the drift, the orientation of the drift, and the azimuth of one of the three electrodes are measured by a Poteclinometer. The correlation curves are of the micro-focused type, reasonably free of the influence of mud cake and wall irregularities.

Paper 19. Rock Type Distribution and Factors Affecting Ultimate Recovery in an Heterogeneous Carbonate Reservoir

Antoine Chueca, Chef du Service Etudes de Department de Production, Societe Esso de Recherches et d'Exploitation Petroliferes, Paris, France

The existence of several different rock-type-productive zones, either calcareous or dolomitic, and either completely separated from or in poor communication with each other, may have an appreciable effect on the ultimate recovery of the field as a whole. Contemplated methods for further improvement of this recovery are presented.

Paper 20. Fluid Injection for Increased Oil Recovery

George Roberts, Jr., and Scott W. Walker, Pan American Petroleum Corporation, Tulsa, Oklahoma

About two-thirds of the oil found in the United States cannot be produced by primary methods. However, over the next 50 years, fluid injection methods may yield an additional 85 billion bbl of oil. Such methods include conventional gas injection, improved gas drives, waterflooding, and thermal methods.

Paper 21. Laboratory and Field Experiments on Fire Flood Recovery Method

Takado Fuchida, Professor, Tokyo University, and Research Group, Teikoku Oil Company, Tokyo, Japan

A discussion of both laboratory and field experiments, with emphasis on the test in the Kogushi First formation of the Niitsu field. Field experiments were generally carried out according to schedule and valuable data were gathered, especially those after air injection was stopped.

Paper 22. Mechanism of Oil Production by Underground Combustion

H. J. Tadema, Koninklijke/Shell Exploration and Production Research Laboratories, Amsterdam, Netherlands

In this picture of underground combustion, the chemical reactions, the phenomena of three-phase flow through a porous medium, and the heat transport by conduction, convection, and condensation are separately considered. It is concluded that a steam drive probably plays an important part.

Paper 23. Theoretical Principles of Hydraulic Fracturing of Oil Strata (NOTE: Paper withdrawn from Congress).

S. A. Christianovitch (et al), Academy of Sciences, U.S.S.R.

Paper 24. Recovery Problems in a Fracture-Pore System — Kirkuk Field

H. A. Freeman, Chief Reservoir Engineer, and S. G. Natanson, Deputy Chief Reservoir Engineer, Iraq Petroleum Company, Ltd., London, England

A case study of a highly fractured, vugular limestone considers the recovery of oil by expansion, displacement by water, and by gas evolution and gas expansion. Consistency of results is emphasized, limitations of the method are pointed out, and the possibilities of further research are discussed.

Paper 25. Effect of Capillary Forces in the Water-Drive Process

H. J. de Haan, Koninklijke/Shell Exploration and Production Research Laboratories, Amsterdam, Netherlands

Various differences observed in laboratory experiments between oil-wet and water-wet systems are explained on the basis of the difference in microscopic fluid distribution between the two systems. The experimental results lead to the conclusion that the effect of capillary forces on the water-drive process is not uniquely determined by a single scaling number.

Paper 26. Results Obtained in the Rumanian Fields from the Resaturation of the Oil Reservoirs

Dumitru N. Codreano, Raoul I. Hauer, Alexandru M. Vernesco, and Gheorghe N. Aldea, Institute of Petroleum Research, Campina, Rumania

Laboratory experiments for displacement of a two-phase system, oil and gas by water, and some methods of predicting the performance of reservoirs producing by partial water drive, have shown the possibility of oil resaturation phenomena occurring in such reservoirs.

Paper 27. Results of Gas Injection in the LL-370 Area — Lake Maracaibo

P. N. Weidner, Chief Petroleum Engineer, and E. R. Bower, Chief Reservoir Engineer, Creole Petroleum Corporation, Caracas, Venezuela

During the first four years of operation of the LL-370 pressure maintenance project, the injection rate has averaged about 130 million cu ft of gas per day. It is expected that gas injection will yield from 30 to 40 percent more oil than could have been achieved by following a pressure depletion program.

Paper 28. Relationship of Vapor-Liquid Equilibrium Ratios at Dewpoint Pressure to Compressibility Factors and Composition of Gas-Condensate Fluids

C. Kenneth Eilerts, Physical Chemist, Nora Potts, Mathematician, and Byron A. Baker, Petroleum and Natural Gas Engineer, Bureau of Mines, U. S. Department of the Interior, Bartlesville, Oklahoma

Two methods are described by calculating vapor-liquid equilibrium ratios of components of gas-condensate fluids at dewpoint temperatures in the range from 70 to 310 F when only the composition of the fluid is known. Measured equilibrium ratios for relatively low pressures may be extrapolated to measured dewpoint pressure at the point of interest.

Paper 29. Agua Grande — A Major Oil Field of South America with Unique Paraffin Problems

G. C. Barroso, General Manager, Reconcavo Basin, and I. B. de Carvalho, Chief Engineer of the Sector of Operation, R.P.Ba., Petrobras, Salvador, Bahia, Brazil

Oil from the Agua Grande field in Bahia, Brazil, is paraffin base, with an average gravity of 40.7 deg API and a pour point in the range of 24 to 32 C. Its characteristics result in a series of unique production problems which occur all the way from the bottom of the well to the refinery.

Paper 30. Recent Improvements and Development Work Concerning Oil Shale Processing at Kvarntorp, Sweden

Edmund K. B. Schianberg, Research Director, and Ake R. L. Brandberg, Research Engineer, The Swedish Shale Oil Company, Kvarntorp, Sweden

Swedish oil shale yields comparatively little oil, and the production of The Swedish Shale Oil Company is therefore based on the recovery of gaseous products. Externally heated retorts are used and the pyrolysis residue is used as heat source in the economically best retorting method.

Paper 31. A Graphical Solution of Fluid Coning Problems in Oil Production

C. Perez Rosales, J. Hefferan Vera, and E. G. Loreto Mendoza, Reservoir Engineering Division, Production Department, Pemex, Mexico

Graphical solution of the fluid coning problem is presented on the basis of theory developed by M. Muskat and W. R. Wyckoff in 1935. Simple nomograms provide the complete solution for two particular cases of well bore and drainage radii.

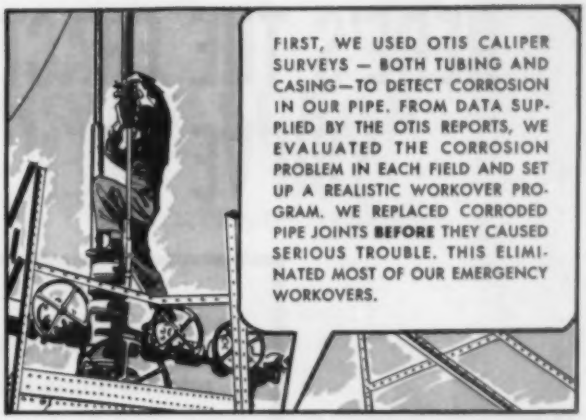
Paper 32. Future Performance of the Cretaceous Limestone of Lower Tamaulipas (Tamaulipas Field) as Controlled by Inert Gas Injection to Avoid the Static Pressure Declination

R. Ruiz M., J. Gomez S., and J. Hefferan V., Reservoir Engineering Division, Production Department, Pemex, Mexico

The paper discusses the future performance of the Lower Tamaulipas Pool on the basis of the volumetric balance equation, by which it is possible to calculate the amount of gas which must be injected in order to maintain, or even increase, the oil production without any drop in reservoir pressure. ★ ★ ★

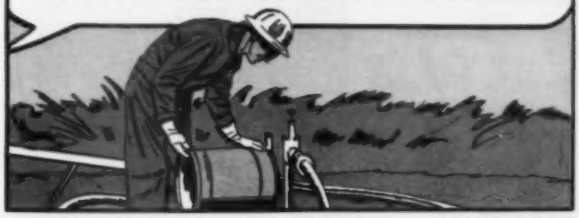
OTIS CORROSION SURVEY SERVICES

AND A STEPPED-UP CORROSION MITIGATION PROGRAM
LET US REDUCE OUR WORKOVER COSTS FROM $500,000 TO $179,000
ANNUALLY. HERE'S HOW WE DID IT.

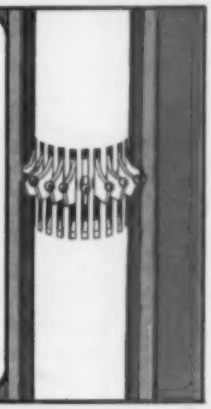


FIRST, WE USED OTIS CALIPER SURVEYS — BOTH TUBING AND CASING—TO DETECT CORROSION IN OUR PIPE. FROM DATA SUPPLIED BY THE OTIS REPORTS, WE EVALUATED THE CORROSION PROBLEM IN EACH FIELD AND SET UP A REALISTIC WORKOVER PROGRAM. WE REPLACED CORRODED PIPE JOINTS **BEFORE** THEY CAUSED SERIOUS TROUBLE. THIS ELIMINATED MOST OF OUR EMERGENCY WORKOVERS.

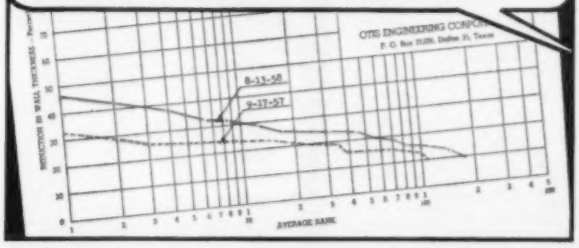
SECOND, WE SCHEDULED PERIODIC OTIS CALIPER SURVEYS TO EVALUATE CORROSION INHIBITORS. WHEN WE'D CHANGE INHIBITORS, OR USE A NEW TECHNIQUE TO APPLY THEM, WE'D HAVE OTIS CALIPER EACH WELL BEFORE WE INTRODUCED THE INHIBITOR AND THEN AGAIN IN FOUR TO SIX MONTHS. THIS GAVE US A CHECK ON THE PROTECTION AFFORDED EACH JOINT OF TUBING IN OUR WELLS — FROM THE BOTTOM TO THE TOP—AND IMPROVED OUR OVER-ALL INHIBITOR PROGRAM.

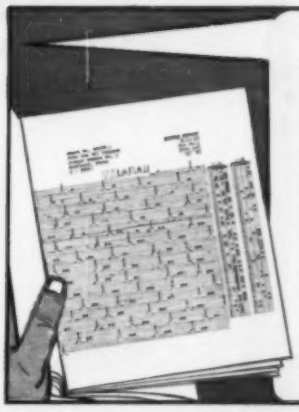


HERE ARE THE PRIMARY REASONS WE PREFER OTIS' CALIPER EQUIPMENT: THEIR INSTRUMENT GIVES US A DIRECT MECHANICAL READING—LESS CHANCE OF DISTORTION. CLOSELY-SPACED SPRING-LOADED FEELERS PRESS AGAINST THE INSIDE WALL OF THE PIPE TO MEASURE THE PIT DEPTHS. AS PITS ARE ENCOUNTERED, DIRECT ACTION FROM THE FEELERS CAUSES A ROTATING STYLUS TO PLOT THE PIT DEPTH AND LOCATION ON A METAL CHART WITHIN THE TOOL.



BESIDES LOCATING AND REPORTING DAMAGE TO PIPE THAT WILL CAUSE IMMEDIATE TROUBLE, OTIS' CORROSION REPORT ALSO INCLUDES A "PIT DEPTH RANK CHART" WHICH RANKS THE PIPE JOINTS ACCORDING TO THE DEGREE OF CORROSION DAMAGE DETECTED. THIS CHART ENABLES US TO EVALUATE OUR CORROSION CONTROL PROGRAM, AND HELPS US ANTICIPATE WORKOVERS AND PIPE REPLACEMENT REQUIREMENTS.





WE BELIEVE THE OTIS CALIPER SURVEY REPORT IS THE MOST COMPLETE WE CAN GET. IT INCLUDES — (1) A WRITTEN INTERPRETATION OF THE CALIPER CHARTS; (2) ENLARGED PHOTOCOPIES OF THE ORIGINAL METAL CHARTS TAKEN FROM THE CALIPERING TOOL; (3) A JOINT-BY-JOINT CLASSIFICATION SHEET, AND (4) THE PIT DEPTH RANK CHART. WHAT'S MORE, WE KNOW WE CAN RELY UPON THE INTERPRETATION GIVEN EACH OTIS CALIPER SURVEY.

THERE ARE OTHER WAYS YOU CAN USE OTIS' CALIPER SERVICE TO REDUCE WORKOVER COSTS. HAVE OTIS CALIPER PIPE IN THE YARD SO THAT YOU CAN SEGREGATE THE JOINTS FOR DIFFERENT USE. HAVE OTIS RUN ROD WEAR SURVEYS — AND CALIPER OLD PRODUCING WELLS YOU PURCHASE TO DETERMINE THE CONDITION OF THE PIPE, AND TO LOCATE SUB-SURFACE EQUIPMENT IN THE WELL.

OTIS' CORROSION SPECIALISTS CAN TELL AT A GLANCE AT THEIR CALIPER CHART THE DIFFERENCE BETWEEN PITS, MILL DEFECTS, TUBING COLLARS, OR JUST IRREGULARITIES IN THE TUBING WALL. AND OTIS CAN CALIPER TUBING OR CASING FROM 1¼" UP TO 9⅝". IF YOU WANT TO REDUCE YOUR WORKOVER COSTS AS WE DID — CALL OTIS. LET THEIR CALIPER SERVICE EXPERTS HELP YOU WITH YOUR CORROSION MITIGATION PROGRAM.

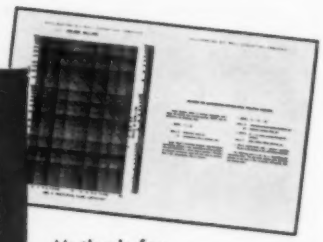
OTIS

OTIS ENGINEERING CORPORATION
General Offices: 6612 Denton Drive • Dallas
Branches Throughout the Oil Country

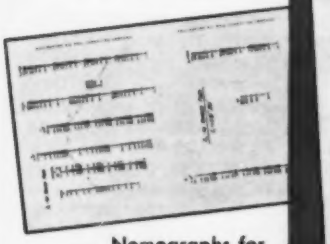
HERE'S THE FRACTURING WORKBOOK YOU'VE BEEN WAITING FOR!

A copy of this extremely current and valuable book is available on request. Be sure and ask for your copy today.

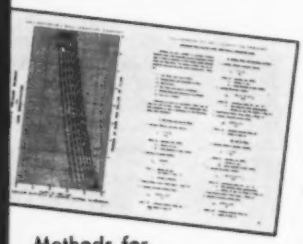
39 Pages of Important and Vital Data Regarding Fracturing.



Methods for Determining Bottom Hole Treating Pressure.

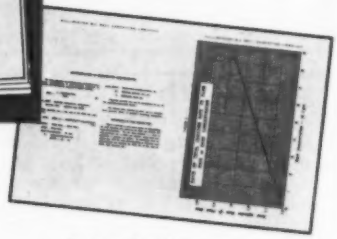


Nomographs for Calculating Fracturing Fluid Efficiencies.



Methods for Calculating Frictional Pressure Loss.

Area and Sand Quantity Calculations.



Determination of Horsepower Requirements.

HALLIBURTON

FRACTURING SERVICES

"TODAY'S RESEARCH – TOMORROW'S PROFIT"

HALLIBURTON OIL WELL CEMENTING COMPANY – DUNCAN, OKLAHOMA

POSITION A

LEBUS WASHPIPE SPEAR

Recover Stuck Drill Stem by the Washover System

Fishing hazards of stuck drill stem overcome with new recovery technique.

First always select a well related OD and ID size of washpipe with the rotary shoe on the bottom to ream over and cut sticking formation loose as the washpipe is rotated inside the well bore and over the stuck drill stem.

Before going into the hole, always anchor a LeBus Washpipe Spear in the washover pipe, approximately 30′ above your rotary shoe. This spear is anchored BIG TONG TIGHT inside the washover pipe by the catching slips. After the washpipe is maneuvered over the stuck drill stem, it is then lowered to a point where the LeBus Washpipe Spear is tightened into the joint at the top of the stuck stem. The spear then becomes a part of your stuck drill stem.

After this has been done you are ready to unanchor the spear slips and to wash-over and loosen your stuck drill stem. If the drill stem is stuck up in the wall of the well and is washed loose, the slips on the spear automatically catch inside the wall of the washpipe to keep the bit and drill stem from falling to the bottom of the well. This prevents possible damage and definitely prevents additional fishing, which would be necessary if your drill stem were to fall.

The washover system of loosening a long string of stuck drill stem is set up in the same manner as pointed out above, except that the Wash-over and removal is done in sections. If a long string of drill stem is stuck, then the limited length of washover pipe that is practical to operate over the stuck drill stem makes it mandatory to washover and make a shot break the joint connection at the bottom of the WASHED OVER section of drill stem. The spear can be used to back off these sections and bring them out without coming out of and going back into the hole with the fishing string as each section is recovered. In practically all washover jobs with the LeBus Washpipe Spear, a safety joint should be used between the spear and the stuck drill stem. This safety joint can be operated for release by the washpipe and spear. A combination right or left hand unlatching joint can be furnished by LeBus International Engineers.

LeBus Washpipe Spear can be located at any point in the washpipe without use of special landing collars or nipples.

This spear is anchored tong-tight inside the washpipe by the catching slips; this makes it easy to place spear in selected position.

Spear is always operative to automatically catch fish when Washpipe is being rotated; at a standstill; being raised or lowered to make Kelly connection or for freeing the Washpipe and reaming shoe.

Spear operates by both hydraulic and mechanical action when fish starts to fall – both operating within 12 inches.

POSITION B

POSITION A

Slips in a down and retracted position; friction block cage in downward position where it will rotate with the washpipe during the wash-over operation.
Spear is also placed into wash-over pipe in this position.

Operating license and spears furnished under lease agreement to all fishing tool companies, oil companies, or drilling contractors in foreign fields. To Fishing Tool Companies only in the Continental United States. Write for operating manual, or at your request a WOSECO engineer will call and give you all operating facts and licensing details.

PATENT NOS. 2,804,151 AND 2,817,555 AND OTHER PATENTS PENDING

POSITION B

Catching and holding position; the spear is actuated into this position by raising the wash pipe or when the drill stem drops. This catching prevents the drill stem from dropping to the bottom of the well.

WASH OVERSHOT & SPEAR ENGINEERS, INC.

BOX 2352, LONGVIEW, TEXAS **PHONE PLaza 8-5522**

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

REED
FIRST in the field . . .
FIRST in experience . . .
FIRST with tool joints
for light weight drill pipe!

Reed was designing and making tool joints for light weight pipe as early as 1948.

Reed Wide Open tool joints have been *proved* in the field on more than two million feet of drill pipe. Some light weight strings with Reed Wide Open joints have made more than 300,000 feet of hole.

Naturally you want the best tool joints made for your light weight drill pipe. The answer is Reed-designed Wide Open tool joints — tested and proved in the field, interchangeable in most sizes with API internal flush working connections, with an I.D. that matches the I.D. of light weight drill pipe.

Only Reed offers a tool joint that is right for every drilling need. When you buy tool joints, buy Reed!

The Reed end seal is stronger in torsion than the pipe body. The mating end seal design assures positive shoulder seal contact . . . no threads to interfere.

REED

SUPER SHRINK-GRIP AND FLASH WELDED

TOOL JOINTS

REED ROLLER BIT COMPANY

Houston 1, Texas

EXPORT OFFICE: 1011 INTERNATIONAL BLDG., NEW YORK 20, N. Y.

GULF COAST, MID-CONTINENT, ROCKY MOUNTAIN AND CANADIAN DISTRIBUTOR FOR MARTIN-DECKER PRODUCTS

REED'S ROLLIN'

Wherever there is drilling . . .
Rib-Tops are 1st choice in V-belts

Gates Rib-Tops are the ONLY V-belts specifically designed for mud pumps. Their superior design and construction insure longer life . . . much lower belt replacement costs . . . and downtime is reduced to a minimum.

Yet Rib-Tops cost no more than ordinary belts of comparable ratings.

Both Standard and Super Rib-Tops are available at your oil field supply house.

Use *Super* Rib-Top for Your Toughest Drives

With 40% greater horsepower capacity, Super Rib-Top easily handles overloads. Fewer belts and narrower sheaves solve space and weight problems.

The Gates Rubber Company

Denver, Colorado

The Mark of Gates *Specialized Research*

No other V-belt has ALL these advantages

1. Stabilizing ribbed tops (U.S. Pat. 2548135) are exclusive with Gates. They dampen vibration, protect top of belt from damage, keep belt running smoothly over idler-equipped mud pump drives with no side whip.

2. Flex-Weave Cover (U.S. Pat. 2519390) A Gates exclusive: provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . . more power available to machine.

3. Concave sidewalls (U.S. Pat. 1813698) Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . longer belt life.

4. Tougher, more resilient cords are able to absorb the severe pulsations of mud pumps; easily handle peak loads.

TPA-401

Gates Rib-Top Vulco Rope

DEVELOPED ESPECIALLY FOR MUD PUMP DRIVES

Understanding various **LEGAL SYSTEMS** *that exist today is the* **KEY TO** *successful* **INTERNATIONAL** *exploration ventures and development of world-wide* **OIL** *operations*

Wm. A. Sackmann,
Attorney, Foreign Production Group
The Ohio Oil Company
Findlay, Ohio

TWO BASIC SYSTEMS of law govern mineral ownership in the world; first, the Common Law System, basically that of the United States and Britain, and second, the Civil Law System, or national law system as it is sometimes called, prevalent in France, Spain, and Latin America, to name a few.

Common Law. "In the United States, the law of minerals is basically that of the English Common Law so that the private surface owner is also the owner of the underlying minerals, whether solid or oil and gas."[1] Title to minerals in public lands is in the federal government, except as given to the states through original settlement, or as disposed of by grant or cession.[2]

Civil Law. Civil Law theory of mineral ownership is not quite so simple, since it is generally divided into several systems, which vary somewhat from each other, and even authors on the subject seem to have difficulty agreeing as to the particular sphere in which mineral ownership falls, such as in the Latin American countries where the metal minerals may be classified as falling within one category and hydrocarbons in another.

Authors are in general agreement that three systems or categories prevail in the Civil Law, being Res Nullius, Accession and Regalia systems.

The Res Nullius system adheres to the concept that minerals belong to no one until they have been discovered or reduced to possession. The Accession system generally is used to describe the concept that the owner of the land is the owner of the subsoil, which is practically the same concept as the Common Law. The Regalia system, sometimes referred to as the Royalty system of ownership of minerals, is generally thought of as ownership by the state, at least to the extent that the state has the right to regulate the exploitation of the minerals and receive an amount in the form of royalty tax for granting the privilege.

Now let's look at the methods or systems used to allow an oil company to enter a country and explore for and exploit the minerals. Generally, one might state that the right to explore and exploit the minerals lies in the constitutions, and the administrative, public and commercial laws of a particular country. For discussion purposes, I shall divide these concepts into:

United States and Canadian system
Nationalistic system
Concession system, in form of negotiated contracts
Concession system, under specific petroleum laws

United States and Canadian System

The Common Law system prevails in both of these countries; however, in the United States the subsoil rights are held more extensively by private individuals than in Canada where subsoil rights are primarily held by the government. Minerals can be owned and disposed of separately from the general title to the land in both of these countries, and the federal governments of both countries have separated mineral ownership from surface ownership when granting homesteads, rights-of-way or setting up school lands. When the first homesteads were granted by the United States, the minerals followed the surface ownership; in later years, reservation of the minerals to the Federal Government became the practice.

Whether or not minerals followed a right-of-way grant to the railroads in the West has been a source of concern to oil attorneys and many cases have gone to the United States Supreme Court for decisions on this very question.

Canada has also followed the practice of separating subsoil rights from the surface rights. The ownership of subsurface rights in Canada by the Hudson Bay Company and the Canadian Pacific Railway stem from governmental action, and give these two companies substantial subsoil rights, in addition to surface rights.

1. Principles of Mineral ownership in the Civil Law and Common Law Systems paper given by Nicholas J. Campbell, Jr., before Section of International and Comparative Law of the American Bar Association in New Orleans, November 1955.
2. 58 C. J. S. 60

H

Serving the oil industry for more than a quarter-century — with inventive know-how and the best service in the business.

This one will jar you!

This combination jar and keyseat broach is an improved design — engineered to provide positive jarring action when necessary.

With more cutting surfaces than ever before, this Hunt-McClinton tool does a faster, better job.

For details, write Hunt Tool Company or telephone Houston. FA 3-7131.

built on good service

HUNT
TOOL COMPANY
Houston, Texas

In both countries a similar pattern of development is followed, being the lease system. Generally, rather small areas of land are granted either by individuals or the government for exploration and exploitation. In Canada a reservation or permit for preliminary reconnaissance will be granted by the government and also by the Canadian Pacific Railway, this grant is for a very limited period of time varying from a four-month renewable term in Alberta to a three-year term in the Northwest Territories, Saskatchewan, and Manitoba.

These reservations or permits generally require some work obligation on the part of the lessee with a credit of approximately one-half of the approved expenditures being allowed as credits against rentals.[3] The Canadian Pacific Railroad also issues a reservation, which had previously been for a period of one year, with the understood right of renewal, but this has now changed. At any rate, leases in the ordinary sense are the usual method of obtaining the right to drill for and produce hydrocarbons in both Canada and the United States.

Canadian leases do not vary too much from those used in the United States. One of the provisions or features of leases in the United States and Canada as distinguished from those of other countries is the term of the grant, which in both United States and Canada lasts so long as production in commercial quantities continues, where in most other countries it is granted only for a specified period, sometimes with the right of renewal.[4]

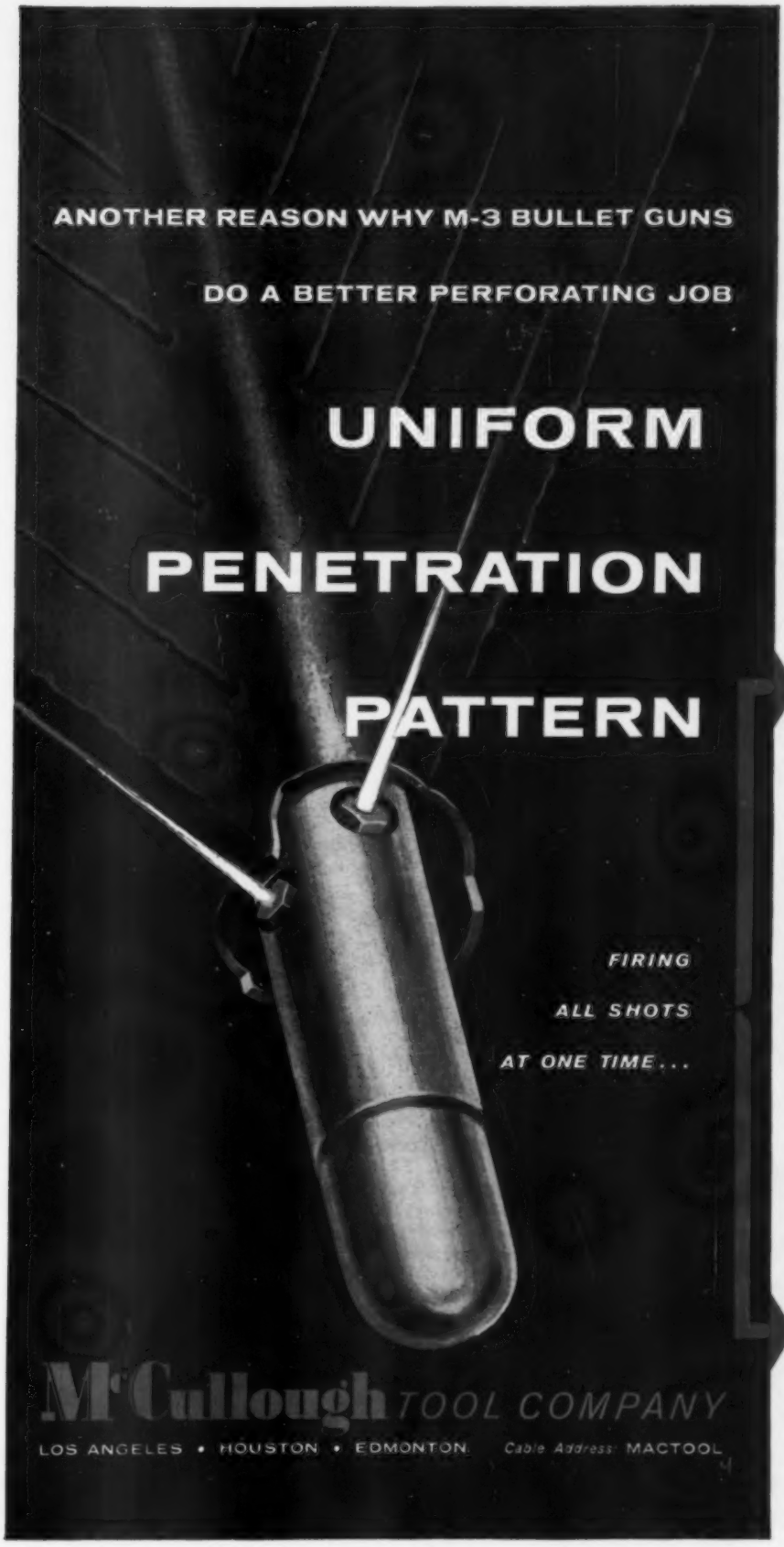
Under both United States and Canadian systems, encouragement is given in the way of depletion allowances for exploration and exploitation activities. Also, one finds provisions either in Federal or State statutes governing production activities to avoid waste. Conservation and proration systems in effect in Texas, Louisiana, and Oklahoma, as examples, are also found in Alberta, Canada. In addition, under the laws of both United States and Canada, the right to unitize operations to prevent waste and more economically produce an area is granted, as found in Federal and State statutes in the United States, as well as in the conservation laws of Alberta and Saskatchewan.

Nationalistic or Semi-Nationalistic System

Countries such as Brazil, Mexico, Chile and until recently, Argentina have followed the pattern of striving to explore and develop their own natural

3. Canadian Oil & Gas, Vol. 2, by Lewis and Thompson.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

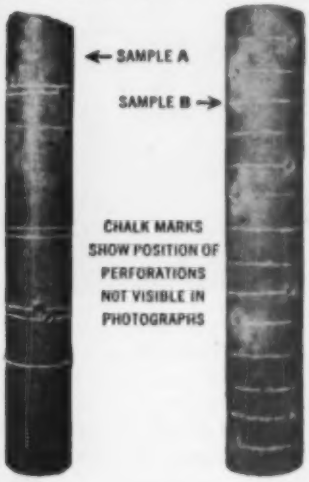


Deep, evenly spaced perforations that *uniformly* cover the productive zone—assure you of the most effective perforating job—and that's what you get when you shoot for production with McCullough M-3 Bullet Guns.

An M-3 Gun fires all shots at one time while the gun is motionless in the casing. Thus, perforations are the exact pattern of the chambers in the gun—in any shot density desired.

Combine McCullough's precise depth measurements with deep, evenly spaced perforations covering the *entire* pay zone and you get maximum drainage from formation to well bore—best possible production.

prevents bunching of shots in one small area in pay zone, giving insufficient coverage—prevents scattering of shots over a wide area, possibly missing the pay zone entirely. Sample A (actual photo of pipe recovered from well) shows the erratic shot pattern produced by a gun firing one shot at a time. As each shot is fired the upward thrust of released gases causes the gun to dance up and down.



eliminates the danger of possible pipe damage or failure. Too many perforations in one spot or in a coupling can cause pipe to part if it is in severe tension. Sample B is an actual example of six shots per foot fired by an M-3 Bullet Gun. Note the uniformity of shot pattern—no danger here of seriously weakening your casing, and you get the most productive perforating job possible.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

BJ SWABS

- More swabbing for your money
- Free falling
- Choice of two rubber designs
- Rubbers last longer
- Disc-type dumps overloads
- Simple four-part design
- Positive seal

Sold through supply stores

Byron Jackson Tools, Inc.

A SUBSIDIARY OF BORG-WARNER CORPORATION

Los Angeles Houston

The Author

William A. Sackmann *is attorney for the Foreign Production Group of The Ohio Oil Company. Admitted to practice law for Colorado, Wyoming and Ohio, and Federal Courts, Sackmann is former assistant attorney general for the state of Colorado. He has also been an instructor of law at the University of Denver Law School. He is a member of the Wyoming, Ohio and American Bar Associations and also the American Society of International Law. He holds a BS degree from the University of Colorado and LLB degree from the University of Denver.*

resources, excluding foreigners and also their own nationals from this right. To develop petroleum resources, these countries generally set up a governmental agency or company, such as in Argentina, Yacimientos Petroliferos Fiscales, a wholly-owned Argentine-government company, known as YPF, is the governing agency, and in Mexico, Petroleos Mexicanos, known as Pemex, a wholly-owned Mexico-government company, carries on these activities. The state agency in Chile is Empreso Nacional del Petroleo ENAP. Communist countries, of course, follow this pattern of government ownership and control of petroleum operations, including China, USSR, Hungary, Rumania, Albania and Bulgaria, to name a few.

Until very recently, the Bolivian government had operated oil activities as a virtual monopoly through two state agencies, one for transportation and marketing, and the other for exploration and development, but on October 26, 1955, a Bolivian Petroleum Code was enacted.

Recently contracts for exploration and development were concluded with companies for operations in Argentina. Pan American International, C. M. Loeb Rhoades, Esso, Union and Shell being involved in the major agreements. The terms of these contracts vary but generally call for a brief exploration period of about six years and a 15 to 20-year development and exploitation period, after which the contract ends and all tangible equipment, wells, etc., go to YPF. Generally, obligation to build a pipeline is also included in the contract. The Argentine government has now opened other areas in Argentina to tenders for bids with the above terms, but also, release is on a checkerboard pattern somewhat like the Canadian system.

Brazil handles all of its own exploratory and exploration activities through a government monopoly, Petrobras. The constitution of Brazil provides that exploration and development may only be granted to Brazilian citizens or "companies organized in Brazil,"[5] but by decree the government agency was granted the exclusive right to act. This company is not a wholly-owned government company, but can sell 49 percent of its stock to Brazilians.

Other countries such as Italy, Portugal, Iran, Spain, and France might be considered as semi-nationalistic in their handling of exploration and development of petroleum resources, in that they have established their own government companies to explore and develop petroleum, but also permit individuals and companies to also carry on these activities. Often it is insisted, however, that nationals of the particular country be entitled to also participate in the company used for operations. Turkey, prior to enactment of the recent petroleum law in 1954, had a government monopoly operating and exploring for petroleum. The Venezuela Law of Hydrocarbons provides under Article 3 that the rights "may be exercised directly by the Federal Executive," but so far this has not been done.[6] Spain, on December 22, 1958, passed a favorable petroleum law which opens the door to foreign companies (including American) to enter Spain and Spanish Territories without Spanish participation although percentage of Spanish participation could weigh in favor of applicant where same areas applied for. Regulations governing operations and filing procedures should be issued on or about May 27, 1959.

Negotiated Concession System

Another method of controlling exploration and exploitation of petroleum is by means of a negotiated concession.

4. An exception to this general statement is found in the Province of New Brunswick, which issued a lease for the term of 99 years, with the option of renewal for an additional 99 years under certain conditions. This lease is dated August 16, 1907, and was originally issued to New Brunswick Petroleum Company (Ltd.) by the Surveyor-General of the Province of New Brunswick by direction of the Lieutenant-Governor-in-Council acting for King Edward VII of Great Britain. Ownership is now in New Brunswick Oil Fields, Ltd. The lease bears 5 percent royalty and covers almost all of the Province.

5. Constitution of Brazil, September 24, 1946. *Article 15.2* "Mines and other subsoil wealth, as well as waterfalls, constitute property distinct from that of the soil for the purpose of industrial development or use."
Article 15.3 "The utilization of minerals resources and those of hydraulic energy, depends upon federal authorization or concession, as provided by law. Section 1 — Authorizations or concessions shall be granted *exclusively* to Brazilians, or to concerns organized in the country, the landowner being assured preference for the development . . ."

6. Venezuela — Law of Hydrocarbons, dated August 29, 1955.

Mosler defines a concession as "the grant to an individual of rights under municipal law which touch public interest."[7] The Soviet Union, in granting a concession, stated, "a concession is a contract of the sovereign government with its class enemy — a foreign capitalist . . . From the legal point of view, a concession implies an element of exemption from the general regime established by law. A concessionaire is granted rights to the exploitation of the object of concession which, under general laws, are not granted to a private business."[8] Concessions for oil exploration and exploitation of a negotiated type are those in effect in such countries as Kuwait, Saudi Arabia, Iran, Qatar, Bahrain, Aden, Costa Rica, Iraq, and the Neutral Zone. These concessions cover large areas, and in some instances, such as Kuwait, the entire country.

A negotiated concession necessarily implies that all the terms and conditions governing size, shape, duration, purposes, considerations (including work and drilling obligations), right to assign or surrender, exemptions from taxes and duties, and all other provisions must be included in the concession agreement. This, of course, takes a great deal of foresight, which sometimes is not quite as good as hindsight.

Generally, these contracts are based on the 50-50 profit-sharing concept which originated in Venezuela. However, many differences arise under the various concessions as to calculations of the 50-50 split.

The 50-50 split was introduced into the Middle East in 1950 by the American consortium operating in Saudi Arabia (the formula was, in general, about the same as the income tax law, and its application to extractive industries, in Venezuela), and within two years the formula had been extended to Kuwait, Iraq, Bahrain, and Qatar.

The magic formula of a 50-50 split is apparently under strong pressure for a change as witnessed by recent Iran and Kuwait-Saudi Arabia Neutral Zone agreements recently signed and the recent tax change in Venezuela. It is reported that Aramco may be reviewing its concession terms in view of these new concessions and in Iraq a right to a percentage of crude oil and an interest in refining operations is reported.

The Iran method, after nationalization in 1951, and subsequent agreement establishing an international operating consortium, provided for retention by Iran of 12½ percent of oil produced, either in cash or in kind, and with other rights, give Iran a basis broadly comparable with the simple 50-50 profit split. Iran has now passed a petroleum bill allowing the government agency, NIOC, to negotiate contracts with foreign companies to develop and explore for petroleum in the areas in Iran not covered by the consortium agreement. The 50-50 profit split is applicable, but with the stated desire, coursing through the bill, that a joint company, with NIOC holding at least 30 percent ownership, be established. A choice is given, however, of a joint company or bonus.[9]

On April 24, 1958, an agreement was signed in Tehran, Iran, between NIOC and Pan American Petroleum Corporation (Standard of Indiana — PAPC) covering an area of 16,000 square kilometers offshore in the Persian Gulf. The agreement provides for a joint stock company to be formed to be named Iran Pan American Oil Company (IPAC), said company to be Iranian and subject to Iranian Commercial Code which will carry out operations for NIOC and PAPC. In effect, Iran will receive 75 percent of the profits including tax and PAPC, 25 percent of the profits. An amount of $82,000,000 will be spent in the first 12 years as exploration expense with a $25,000,000 bonus to Iran on ratification by Majlis and Senate. Ownership in the joint stock company would be 50 percent NIOC – 50 percent PAPC, but expenses of exploration would be on Pan American with NIOC in effect being a carried interest. In addition, Pan American agreed to export oil in tankers flying the Iranian flag.[9a] Other clauses in this agreement with NIOC followed the general provisions of a negotiated agreement, except that integrated operations are contemplated.

A similar type of agreement was signed several months ago by Iran with the Italian ENI, who formed the mixed Italian-Iranian concern, SIRIP, but this is the first large American company in the Persian Gulf to agree with the concept of mixed companies with 75-25 division of profits.

New concessions were signed in the Kuwait-Saudi Arabia Neutral Zone offshore area to Japanese interests.

Most recent agreement was signed with Kuwait on May 8, 1958, and follows the general terms of the agreement signed in December 1957, with Saudi Arabia for rights under its half-interest in the offshore neutral zone. These agreements also change the 50-50 split of profits, and it is reported that Kuwait will receive 57 percent of profits and Saudi Arabia 56 percent of profits under the agreements. A sizable production bonus was paid by the Japanese, and the agreements with both rulers provide for a Japanese company with the right of rulers to have members on the Board of Directors. An option to a percentage of the stock is given to the rulers of Kuwait and Saudi Arabia of 10 percent and 20 percent, respectively, upon discovery of oil. The Kuwait agreement provides for use of Kuwait tankers if terms are comparable.

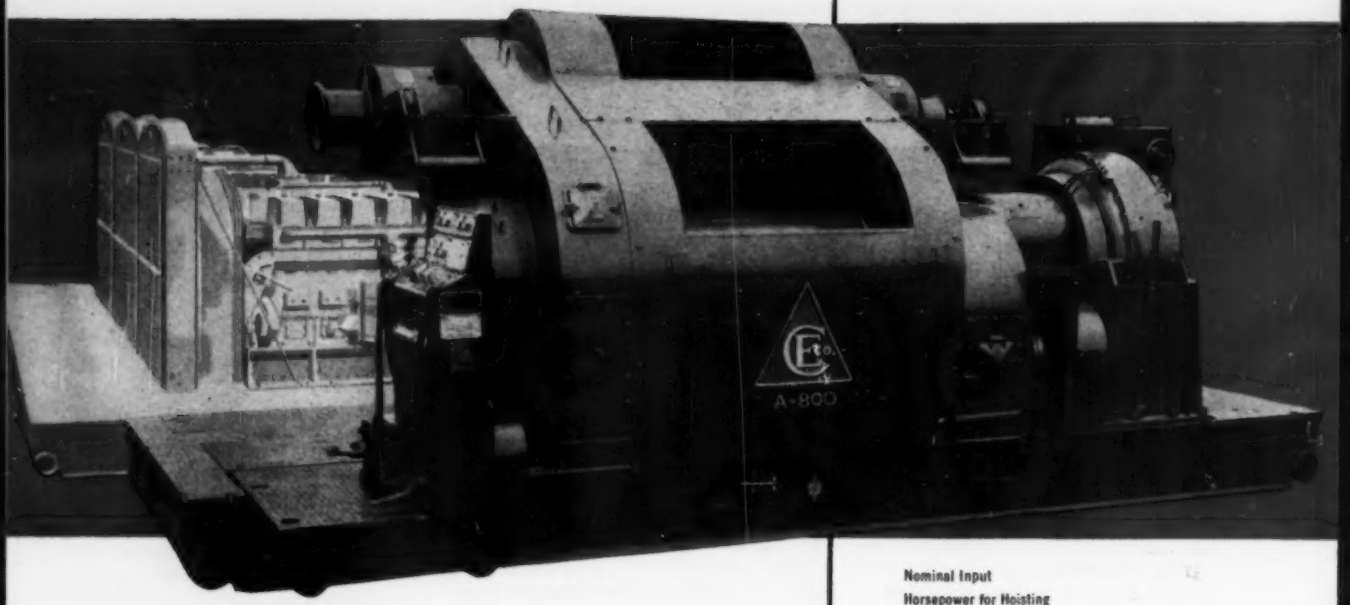
Middle East concessions are for long fixed terms varying from 40 to 99 years.[10] Since some have been renegotiated, the terms run from the date of the new modified agreement. This concept of a fixed term appears to be firmly established, and although it is perhaps not desirable from the operating standpoint, since an operator facing such a limitation may be expected to get all the oil he can while he can, it is a uniform practice,[11] not only in negotiated agreements but in petroleum bills which will be discussed later.

Generally, these concessions provide exemptions from additional taxes, except those then in effect, and provide rights to import materials for operations free of duty. Protection of the right to repatriate capital and profit is also generally found in these contracts. Provisions in the concession that the concessionaire will not engage in politics or political activities seem to be a part of this type of concession. In addition, an alien applicant for a concession may be required to sign an agreement to the effect that he submits himself wholly to the laws of the country and the jurisdiction of its courts, insofar as his business in the particular country is concerned, this is known as the "Calvo Clause." It derives its name from Carlos Calvo, an Argentine judge who was the author of an opinion to the effect that aliens should have no diplomatic recourse when dealing with his government. Our State Department has criticized various governments for insisting on the inclusion of such a clause in agreements, but with little avail.

7. Hermann Mosler—Wirtschaftakonsessionen bei Anderung der Staatschoheit 79, 1948.
8. Vladimir Gsovski, Soviet Civil Law, Vol. II, pg. 68, citing Karass, Concession, Magerovsky, Fundamentals of Soviet Law, 356, 358 (1929).
9. Iranian Petroleum Bill. The order making the Bill effective as law was signed by His Imperial Majesty on August 1, 1957.
9a. Translation of contract between the National Iranian Oil Company and Pan American Petroleum Corporation of April 24, 1958, furnished by Petroleum Times, Supplement to Vol. LXII, No. 1586.
10. Kuwait Concession — 1934 to 2026; Saudi Arabia Concession — Original 1933 to 1999, after modification, 2005; Iraq — Iraq Petroleum Company, 1925 to 2000, Mosul Petroleum Company, 1932 to 2007, Basrah Petroleum Company, 1938 to 2013, Khangin Oil Company, Original Concession 1901, later extended 1926 to 1996; Iran — Original D'Arcy Concession 1901 to 1961, Consortium Agreement commencing in 1954 to 1994; Qatar — 1935 to 2010, on land and offshore concession 1952 to 2027; Bahrain — Original Concession 1940 to 1995, now expires 2024.
11. Problems related to Negotiation of Foreign Oil Concessions, by Burney Braly, given before engineering association meeting in 1955.

CONTINENTAL-EMSCO

A-SERIES rigs are as flexible as your drilling requirements



Power ends for A-Series rigs are designed for maximum *power flexibility* . . two, three or four engines . . 700 to 1800 horsepower . . variety of four pump drive arrangements. Four drawworks sizes provide a wide drilling range. This gives you latitude in assembling the minimum amount of rig equipment . . contract by contract . . to drill at the *lowest possible* cost per foot.

You'll save on rigging-up and tearing-down time too. Sections are easily, quickly assembled . . move in compact, low-cost truck loads.

A-Series rigs open up more jobs for you . . make you *fully competitive* . . help you make more money on each job. Your Continental-Emsco man can give you detailed information . . call him today.

Nominal Input Horsepower for Hoisting
A-550 Rig—700 hp
A-800 Rig—1000 hp
A-1100 Rig—1400 hp
A-1500 Rig—1800 hp

DESIGNED TO CUT DRILLING COSTS.. LABOR COSTS.. INVESTMENT COSTS

CONTINENTAL-EMSCO

Serving the Oil and Gas Industries Worldwide

RB02

CONTINENTAL-EMSCO COMPANY • A Division of The Youngstown Sheet and Tube Company • General Offices: Dallas, Texas
Export Division: 30 Rockefeller Plaza, New York, N. Y. • Continental-Emsco Company Limited • General Offices: Calgary, Alberta, Canada
Continental-Emsco Company C. A., Caracas, Venezuela • Plants: Houston and Garland, Texas; St. Albans, Herts., England • Representatives in All Principal Oil Fields of the World

Creative Engineering maintains the leadership of W-K-M® Through-Conduit Gate Valves

Oil men all over the world pronounce this valve the best production valve they ever used.

Field men recommend it; engineers specify it. Both know that a W-K-M Through-Conduit Valve is a valve that will give them positive control of production pressures with little maintenance over long periods of time, a valve that has won a world-wide reputation for long-range economy.

W-K-M's creative engineering is the reason why. It studies your valve problems, it invents solutions to them, it improves on solutions already made.

Write for Test Bulletin WP-1058

W-K-M Division of ACF Industries, Incorporated,
P. O. Box 2117, Houston 1, Texas

W-K-M Balanced Stem Valves —for 10,000 and 15,000 psi Working Pressure

The "balancing stem" attached to the bottom of the gate balances out body pressure acting against the operating stem, thus eliminating the thrust load normally carried by bearings and threads in single stem valves. The only loads to be overcome in opening or closing this valve are packing friction and normal operating loads. In comparison to the extreme pressure very little effort is required to operate the handwheel.

The design includes parallel expanding gates, two thrust bearings, super-finished stems, and other important features that have established W-K-M's leadership.

Sizes: 15,000 lb. W.P.: 1", 1 13/16", 1 13/16", 2 1/16", 2", 2 9/16"
10,000 lb. W.P.: 2", 2½", 3", 3½"

On Hand

The most used sizes of W-K-M gate valves are carried by supply stores everywhere. Special sizes and special designs are produced as you need them.

W-K-M
SERVING INDUSTRY 40 YEARS

Unless specifically exempted, other laws and regulations of the country are applicable to the concessionaire; therefore, careful study of the applicable laws covering labor, incorporation or registration, investment, taxes, currency, banking, commercial activities, and even insurance, in addition to the constitutional provisions, if any, governing prospective operations in a particular country needs to be made by the attorney advising his company.

System Controlled by Mining Laws or Petroleum Laws

This system of regulating oil exploration and development by means of either a general mining law or a separate petroleum law is found in the majority of the South American countries and it has been adopted in many other countries, the most recent of which is Iran and the new petroleum law in Spain.[12] Subsoil rights are reserved to the nation, either by specific provisions in the constitution[13] or by statute.[14] In the absence of constitutional or statutory provisions on this point, one has to rely on historical or traditional assertion of government ownership of the mineral resources.[15] The concessions issued by the state under the Mining Laws or Petroleum Laws are generally only a temporary right to exploit a mine or reservoir, the ownership of which remains in the state and will continue to be the property of the state after the concession has expired.[16] "State intervention is therefore justified from the legal viewpoint on the basis of protection of state property, rather than on the more illusory basis of public policy or the exercise of police power."[17] The concessions issued by the state under a Petroleum Law generally are broken down into stages:

1. Reconnaissance or Permit Stage
2. Exploration Stage
3. Exploitation Stage

The reconnaissance stage or permit stage is a non-exclusive right to make a general geologic appraisal of an entire country or specified areas of a country.[18] This type of permit is generally for a short period of time such as one year in Libya and Bolivia, but in Turkey the term is set by the administering authorities.[19]

In some countries stages one and two are combined together, such as in Portugal.[20] While others, such as Libya, Colombia and Guatemala, the last two stages are, in reality, combined by providing for the relinquishment of a portion of the area covered by the original petroleum exploration concession, when converting over to the exploitation or development stage.[21]

The exploration stage generally provides for an exclusive right to explore for petroleum substances in a specific area, with the absolute right to apply for a concession for exploitation, either on discovery of petroleum in commercial quantities or by assuming an obligation to drill for oil within a specified time.[22]

The terms of these concessions generally are from three to six years, with an implied right of renewal if certain obligations are met. Many countries now limit the size of these concessions and also limit the number of concessions which can be held by any company. Limitations as to both number of concessions in any area and as to total area are found in the laws of Libya, Guatemala, Turkey, Bolivia, and Colombia, to name a few. The question of holding in undivided shares in countries with both acreage and number limitations has created quite a problem. The generally accepted theory in the United States of joint ownership is quite difficult for the legal minds of other countries to grasp. The exploration type of concession generally requires that the concessionaire spend

12. Countries having either a Petroleum Law or a Mining Law governing the granting of concessions are: Algeria, Australia, Bahamas Islands, Bolivia, British Honduras, Colombia, Cuba, Dominican Republic, Ecuador, Egypt (originally allowed special agreements, under which terms Conorada concession negotiated), France, Germany (East), Guatemala, Haiti, Honduras, India, Indonesia, Iran, Israel, Italy, Libya, Morocco, Pakistan, Panama, Papua, Peru, Philippines, Portugal, Spain, Trinidad, Turkey, United Kingdom, and Venezuela. Other countries such as British Somaliland, Territory of Somaliland (Italian Somaliland), French Sahara, Tunisia, etc., have adopted French, British or Italian systems for administering oil activities, with broad powers in administering authorities to work out satisfactory arrangements.

13. *Guatemala* — Constitution of the Republic of Guatemala effective March 1, 1956, Article 3, "The domain of the Nation includes its territory, soil, subsoil, territorial waters, continental shelf and air space, and includes natural resources and wealth existing therein . . . ."
Cuba — Constitution of the Republic of Cuba, July 5, 1950, Article 88. "The subsoil pertains to the Nation, which can grant concessions for its exploitation, as established by law."
Czechoslovakia — Constitution of June 9, 1948, Fundamental Articles XII. "1. The economic system of the Czechoslovak Republic rests on the nationalization of mineral wealth, industry, the wholesale trade and of finance; . . ."
Indonesia — The Provisional Constitution of the Republic of Indonesia, August 15, 1950, Article 38. (3) "Land and water and the natural riches contained therein shall be controlled by the State and used for the maximum prosperity of the people."

14. *Libya Petroleum Code*, 1955, Article 1 (1). "All petroleum in Libya in its natural state in strata is the property of the Libyan State."
Codigo de Petroleo de la Republica de Guatemala (dated July 7, 1955), Title I, Chapter 1, Article 1. "All of the natural deposits or occurrences of petroleum that are located within the terrestrial or maritime limits of the Republic or within the outer limit of the continental platform belong to the nation."
Egypt, Law No. 66 of 1953 on Mines and Quarries, Chapter I, Article II. "All raw minerals existing in mines and quarries of the Egyptian Kingdom, including the territorial waters, are considered as State property."
Territory of Somaliland, under Italian Administration, Trusteeship Agreement dated December 2, 1950, "Whereas, by Article 23 of the Treaty of Peabe between the Allied and Associated Powers and Italy, signed in Paris on 10 February 1947, Italy renounced all right and title to the Italian Territorial possessions in Africa, ..."
Turkey Petroleum Law of March 16, 1954, Article 1. "The petroleum resources of Turkey are in the possession and under the rule of the State."

15. At one time the French system of ownership was the Accession System, i.e., ownership by the surface owner of the mines contained in the subsoil; however, about 1790 the landowners renounced their ownership of the mineral wealth to the state. The law of July 28, 1791, established the system which prevails today, placing mines and minerals at the disposition of the state, at least to the extent that the mines cannot be exploited without consent of the state.

16. Ibid 1.

17. Ibid 1.

18. *Guatemala* — Ibid 14 — Article 23, states: "The surface reconnaissance right confers the authority to make by any process the topographic, geologic, geophysical and geochemical studies related to petroleum and to carry out the investigations or similar examinations, as well as to undertake drilling to obtain geological data." Article 26 states: "The surface reconnaissance right does not authorize its holders to explore, exploit, refine or transport petroleum nor does it grant exclusively over the area of land subject of the reconnaissance."
Libya — Petroleum Law No. 25 of 1955 — Preliminary Reconnaissance Permit for Petroleum, 1st schedule to said Law. Part 2: "Preliminary exploration for petroleum, includes surface geological reconnaissance, aerial surveys and surface geophysical operations commonly used in the petroleum industry. The drilling of exploration wells, mechanical core drilling and seismic operations will not be allowed under this permit." Article 6(5) states: "The grant of a permit does not of itself entitle the holder thereof to a concession in respect of any area."
Bolivia — Bolivian Petroleum Code, signed by the President October 26, 1955, Article 23 states: "The permit of surface reconnaissance confers only the privilege of reconnaissance of the land which is the object of the authorization and shall not give any right of priority in the obtaining of concessions."
Venezuela — Ibid 6 — Article 2: "All persons, national or foreign . . . may freely undertake surface explorations within the confines of national territory . . . except over lands covered by concessions . . ." The depth of a well under this right is limited to 100 meters.

19. Petroleum Law of the Republic of Turkey dated March 16, 1954, Article 46(2): "The Petroleum Administration may refuse an application for a permit, or may grant it for such term and subject to such limitations and conditions as it may determine."

20. *Portugal* — The concessions issued under the Mining Law of 1930 provide for a preliminary reconnaissance period of 18 months, with exploration period of 48 months. Exploration work must begin on expiration of preliminary period. Portugal —World Petroleum Legislation.

21. *Libya* — Ibid 14 — Article 10. Provides for reduction of 25 percent in 5 years, additional 25 percent in 8 years and finally to 33⅓ percent in 10 years, in Zones I and II, and down to 25 percent in Zones III and IV.
Guatemala — Ibid 14 — Article 35. Provides for return to the Nation of 50 percent of the area originally in exploration stage.
Colombia — The Oil Code of Colombia, Decree 1056 of 1953. Article 23. "The exploration and development of each area applied for shall be covenanted in a single contract."

22. *Guatemala* — Ibid 14 — Article 36. "The holder of an exploration right may elect to convert it into one of exploitation even before he has discovered petroleum . . . providing that . . . (c) he obligates himself to begin drilling within 6 months following the date on which he is granted the exploitation right."
Venezuela — Ibid 6 — Article 7. "Exploration concessions confer upon the concessionaire the inherent right of exploitation of the parcels he may subsequently delimit in the same lot, in accordance with this law." Article 18 provides that the exploitation parcels subsequently granted by an exploitation certificate will not be more than ½ of the lot nor more than 500 hectares.

BUY BETTER...FROM BAROID

The stores where you buy profit

Look for the bright yellow and red Baroid store near you—wherever you drill Baroid men know YOUR needs. They are setting new records for prompt, complete delivery of mud products that help you drill faster and with more assurance of profit to you.

BAROID

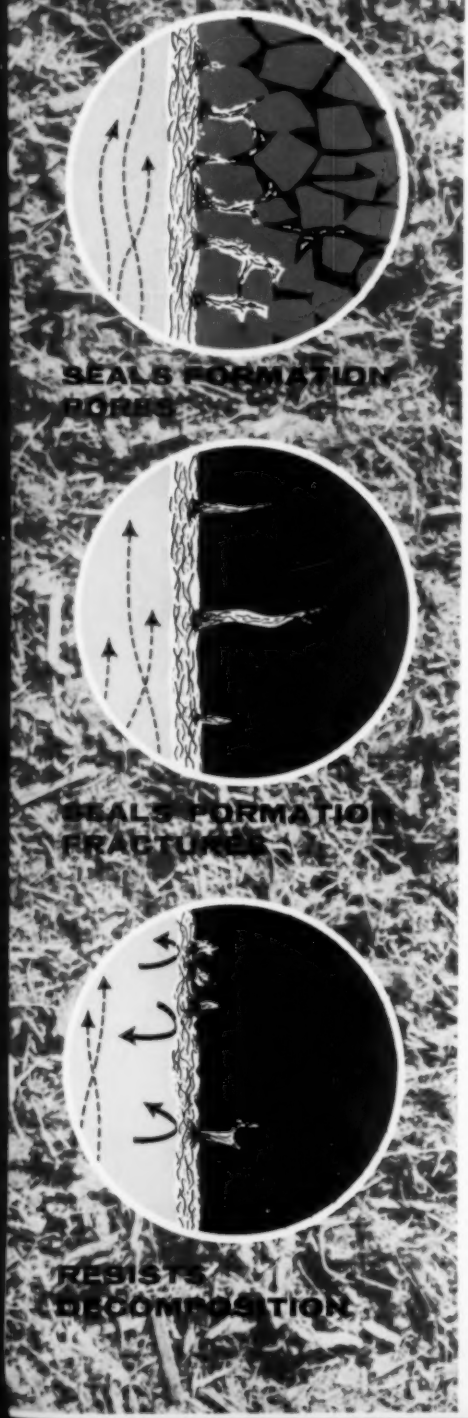
BAROID DIVISION • NATIONAL LEAD COMPANY

MAIN OFFICE: P. O. BOX 1675, HOUSTON 1, TEXAS

5907

Seeing is believing

FIBERTEX*



strong fibers *permit mud circulation without loss.*

FIBERTEX . . . bridges formation pores and blocks fractures to prevent or stop mud loss.

FIBERTEX . . . graded fiber sizes give quicker, more effective sealing.

FIBERTEX . . . mixes easily, works fast, resists decomposition. A little goes a long way.

BAROID

BAROID DIVISION
NATIONAL LEAD CO.

Main Office: P. O. Box 1675, Houston 1, Texas

* Registered Trademark, Baroid Division National Lead Co.

5906

a minimum amount in geological investigations, in addition to a rental provision. In some instances, such as in Guatemala, the expenditures made in geological investigations are credited against the amount of rental payable.

The exploitation stage, as the name implies, grants the right to extract petroleum substances from the area covered by the exploitation concession. The terms of these grants vary anywhere from 30 to 50 years,[23] and generally carry some right of renewal, either on the same terms or on terms as to royalty and tax provisions in effect at the time at which extension is granted. Libya, for instance, grants the concession for 50 years with a right of renewal of an additional 10 years. In some countries the area that can be held varies in different districts of the country. Libya has divided the country into four zones and gives a bit better deal at least as to size in zones farther from the coast. Colombia has allowed for better treatment in areas situated East and Southeast of the summit of the Eastern Cordillera. Provision for royalty or royalty tax, also referred to as production tax, varies from 3 percent to 16⅔ percent, with 12½ percent apparently being the most prevalent. The 3 percent figure is used in Colombia where the oil activities are more than 900 kilometers from the port of shipment. The recent Iranian Oil Bill provides for the operator to supply in kind to NIOC, the one-eighth of the total production, which shall be deductible from the operator's tax liability. The now prevalent 50-50 split concept has crept into most of the more recent petroleum codes.

This is not the place to discuss this concept, suffice to state that some governments, having become dissatisfied with the royalties provided by law or contract, have forced producers to hand over a much larger share of the production. More and more agreements seem to be coming about with the concept of government participation in the search and exploitation of oil.

It is always important to ascertain whether or not a concession can be assigned and relinquished; however, most petroleum laws so provide. However, as I stated previously, the concept of holding in undivided shares seems to shake the administering agencies in some countries. Generally, this right of assignment is granted only upon condition of approval by the government. This is necessary in Libya and

Most petroleum laws provide for in Guatemala.

23. Libya — 50 years; Colombia — 30 years, extension of 10 years; Venezuela — 40 years; Guatemala — 40 years, extension of 20 years; Bolivia — 40 years; Turkey — 40 years, renewable for additional 20 years.

exoneration, either in whole or in part of import duties and taxes; however, this may come about only by being able to have these payments applied against the total obligations to the government under a 50-50 net profit sharing agreement or deducted in computing the net profits to be shared by the government. Also, the laws generally provide for an exemption from export taxes as to petroleum and petroleum products. Many codes provide for a depletion allowance, such as in Guatemala of 27½ percent and in Bolivia of 27 percent, to be used in calculating the income tax.[24] Another common provision which we find in petroleum laws or codes is one requiring a bond or guarantee for performance of concession terms, this is generally taken care of by having a bank issue a letter of credit or guarantee to the administering authority, which, in turn, is underwritten by a guarantee bond by the company to the bank. The charge is generally nominal, but the banks generally require the guarantee to them to be made by the parent corporation rather than the subsidiary. Most petroleum laws provide that the applicant must prove its technical and financial ability to carry out activities and obligations connected with both the exploration and exploitation stages. This is generally met by filing the balance sheets and profit and loss statements of the parent company and the subsidiary company, together with a certificate showing the percentage of ownership in the subsidiary by the parent company, this generally seems to suffice.

Other familiar provisions which seem to appear in most petroleum laws are:

1. Right to a refining and transportation (pipeline) concession;
2. Obligation to train a certain number of the countries' nationals in petroleum operations;
3. Obligation to hire a certain percentage of nationals, this varies from 70 to 80 percent of the total number of persons employed;
4. Necessity to prevent waste;
5. Right to use construction materials, wood and water from national lands;
6. Right to surrender, either in whole or in part, the concessions;
7. The obligation to carry out exploration and exploitation activities in compliance with good oilfield practices;
8. Method of compensation for use of land owned by private owners;
9. Free transfer of currency and of property; however, this right is frequently restricted, such as in Venezuela where the oil companies sell bolivars at 3.09 B's to the dollar when the official rate is around 3.33 B's to the dollar;
10. Right to repatriate profits.

24. Among countries providing for depletion allowances are: Bolivia, Colombia, France, Guatemala, India, Libya, Pakistan, Turkey, Peru, and Trinidad.

In addition to the above, the concessionaire must comply with all of the commercial and civil codes of the country which are applicable and not specifically exempted by the petroleum law. Therefore, registration of the company, the keeping of accounting records and all other matters covering the companies' activities including registration of employees (since we are aliens), withholding of taxes, payment of social security benefits, compliance with local labor laws and in general, filing all statements, documents, certificates and other instruments that the various administering authorities require, must be carefully followed. In this connection, many laws provide that the language of the country prevails; therefore, as in Libya, Arabic is the official language and when any document is filed, the Arabic text is the official text and the English is considered as a translation of the Arabic.

The legal aspects of a foreign investment are all important to any company planning an international investment. Foreign governments necessarily are concerned both directly and indirectly.

This discussion has been based primarily on the contractual arrangements which are worked out with agencies of foreign governments, but prior to any investment, a careful analysis of our own government's laws and regulations must be undertaken, as our legal system is superimposed on the legal systems of the foreign government whenever an American company undertakes operations.

General Bibliography

Constitutions of Nations, by Peaslee

Foreign Investment and Taxation, by Barlow and Wender

Foreign Tax and Trade Briefs, by W. H. Diamond

Export and Import Practice, U. S. Department of Commerce

Constitutions, Electoral Laws and Treaties in the Near and Middle East, by Davis

World Petroleum Report, special annual review of International Oil Operations of January 15, 1957

World Petroleum Legislation, edited by Gordan H. Barrows

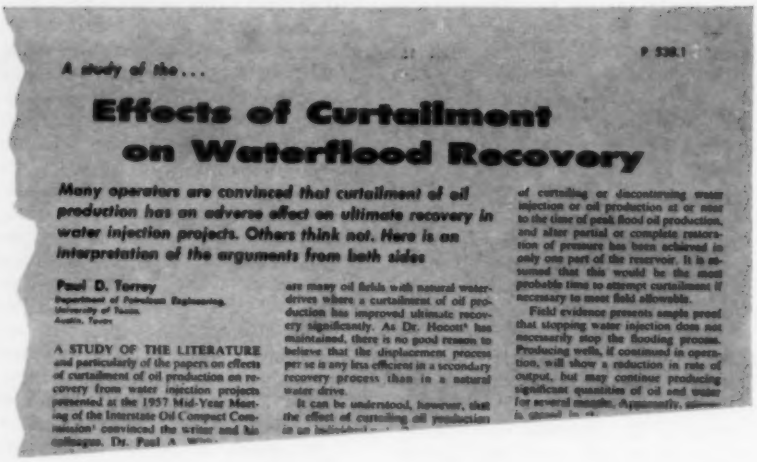
"The Settlement of International Investment Disputes," address delivered at the International Investment Law Conference in Washington, D. C., on February 24, 1956, by Martin Domke

"Some International and Legal Aspects of the Suez Canal Question" by Thomas F. Huang, appearing in *The American Journal of International Law* of April, 1957.

★ ★ ★

Further Discussion of

In reply to an article published by Dr. Paul D. Torrey in the December, 1958, issue of ***The Petroleum Engineer,*** *this discussion has been prepared by W. M. McCardell, chief research engineer, Humble Oil & Refining Company.*



A study of the...

P 538.1

Effects of Curtailment on Waterflood Recovery

Many operators are convinced that curtailment of oil production has an adverse effect on ultimate recovery in water injection projects. Others think not. Here is an interpretation of the arguments from both sides

Paul D. Torrey

Department of Petroleum Engineering, University of Texas, Austin, Texas

A STUDY OF THE LITERATURE and particularly of the papers on effects of curtailment of oil production on recovery from water injection projects presented at the 1957 Mid-Year Meeting of the Interstate Oil Compact Commission[1] convinced the writer and his colleague, Dr. Paul A. Witherspoon, that there are many oil fields with natural water-drives where a curtailment of oil production has improved ultimate recovery significantly. As Dr. Hocott[2] has maintained, there is no good reason to believe that the displacement process per se is any less efficient in a secondary recovery process than in a natural water drive.

It can be understood, however, that the effect of curtailing oil production in an individual ... of curtailing or discontinuing water injection or oil production at or near to the time of peak flood oil production, and after partial or complete restoration of pressure has been achieved in only one part of the reservoir. It is assumed that this would be the most probable time to attempt curtailment if necessary to meet field allowable.

Field evidence presents ample proof that stopping water injection does not necessarily stop the flooding process. Producing wells, if continued in operation, will show a reduction in rate of output, but may continue producing significant quantities of oil and water for several months. Apparently, ... is shown in ...

W. M. McCardell, *Chief Research Engineer, Production Department*
Humble Oil & Refining Company, Houston, Texas

AN ARTICLE entitled "Effects of Curtailment on Waterflood Recovery" by Dr. Paul D. Torrey was published in the December 1958, issue of *The Petroleum Engineer*. The paper resulted from Dr. Torrey's and Dr. Paul A. Witherspoon's convictions that much of the evidence developed on this controversial topic was subject to definite reconciliation by fair and constructive interpretation. While in general agreement with the conclusions presented in Dr. Torrey's paper, the present author believes that the text contains certain statements concerning oil migration, variations in reservoir permeability, and interpretation of field performance which require additional clarification. It is the intent of the following discussion to attempt such clarification, for, indeed, clear understanding of these points is vital to application of Dr. Torrey's conclusions.

Dr. Torrey's Conclusions

Dr. Torrey states in his conclusions that, if curtailed projects could be produced profitably over extended periods of time, no physical loss of oil would be likely to occur and emphasizes that uncurtailed projects are more profitable than curtailed ones. His conclusions on page B-74 of the original article are quoted in full as follows:

"In reviewing literature relating to the problem of curtailment, it is apparent that economic conditions have influenced many of the opinions expressed on this subject. It is evident that if most of the projects cited as examples had not been curtailed in one way or another they would have been more profitable. Thus, the profit motive is as important in the development of secondary oil reserves as in the development of primary oil reserves. If the economic factor of time did not reduce income there probably would be little complaint about the damage resulting from prorated secondary oil production. Furthermore, if it should be possible to produce curtailed secondary water floods profitably over extended periods of time it is likely that the same amount of oil, or even more oil could be produced as would have been the case if production from them had not been curtailed. The difference in the thinking of the operators, of course, is that the uncurtailed projects are usually more profitable than the curtailed ones."

A key phrase in the Conclusions is, *"If it should be possible to produce curtailed secondary water floods profitably over extended periods of time,* it is likely that the same amount of oil or even more oil could be produced as would have been the case if production from them had not been curtailed." A clear understanding of the factors which make it either possible or impossible to produce curtailed floods profitably is necessary before this conclusion has specific application in individual flooding projects.

In the text, on page B-72, the discussion leaves the implication that it might not be possible to produce curtailed floods profitably over a long enough period of time to achieve the same or greater recovery than would be obtainable by an uncurtailed flood. This thought was introduced both in discussion of the effects of permeability variations in the reservoir and in interpretation of a field history. Both deserve additional discussion.

Variations in Permeability Profile

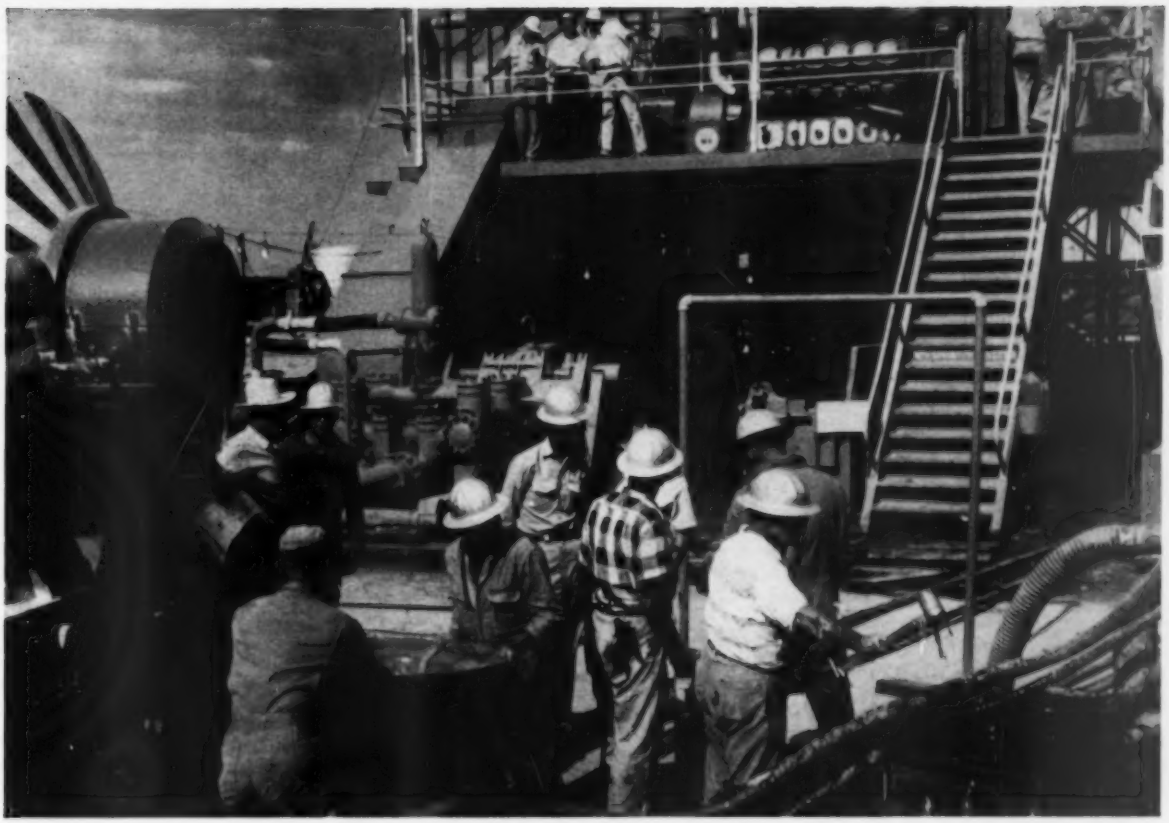
Dr. Torrey states (p. B-72):

"Furthermore, no one is likely to deny the relation between increase in water saturation in the pore system of the reservoir and increase in its permeability to water. Thus, if injected water travels at different rates through the reservoir due to variations in the permeability profile, it will be essential to inject water into the tighter sections of the reservoir so that oil may be produced from this before water begins to move through the more permeable sections at such a high rate resulting from increased permeability to water, that increased water-oil ratios will increase to an extent no longer profitable. Otherwise, the well may be abandoned long before oil can be recovered from the tighter sections of the reservoir."

The statement is quite true — it is necessary for water to enter the tighter sections of the reservoir. It might be desirable to inject selectively into the tight zones if the well perforation interval could be so controlled. However, it is not necessary to inject water from the well bore directly into the tight zones. Water will move spontaneously from the more permeable to the less permeable as a result of capillary pressure. In fact, such movement cannot be prevented. Just as no one is likely to deny the relation between increased water saturation and increased water permeability, so no one is likely to deny the relation between changes in water saturation and changes in capillary pressure.

At the beginning of flooding, the capillary pressures in contiguous highly permeable and less permeable zones is, of course, equalized. When flooding begins, water tends to move more rapidly into the highly permeable zone. As the water saturation in the more permeable zone increases, the capillary pressure in that zone changes. The equivalence in capillary pressure between the two zones is upset, and because of this difference in pressure, fluids will interchange between the two zones until the capillary pressures are again the same. This interchange process results in a flow of water into the tight zone from the more permeable with a countercurrent expulsion of oil from the tight into the more permeable.

Dr. Torrey continues his statement



DIACEL* CEMENT SYSTEMS
Control Thickening Time and Density!
Control Fluid Loss, Too... All At Low Cost...

Good reasons for the ever-increasing use of DIACEL Systems in cementing oil and gas wells.

DIACEL CEMENT SYSTEMS help overcome the problems of excessive channeling, flash setting and pipe sticking during cementing. Versatile DIACEL additives also permit economical and convenient tailor-blending of cements for wells of any depth and a wide range of temperatures.

DIACEL D—A special grade of diatomaceous earth blended with portland cement (with or without an accelerator) to make slurries with densities as low as 10.5 lbs./gallon. Slurries containing DIACEL are actually more economical than those of straight common cement.

DIACEL LWL—A cellulose derivative that controls fluid loss and retards thickening time of slurries. It permits safe placement in deep, high-temperature wells and protects against pipe sticking, flash setting, and pay-zone water damage while cementing.

DIACEL A—A special type of sodium silicate accelerator. It permits placement of low water loss cements over a greater range of temperatures.

For complete details and technical literature, contact your Drilling Specialties field engineer... or your cement service company.

DRILLING SPECIALTIES COMPANY
Bartlesville, Oklahoma

*A trademark

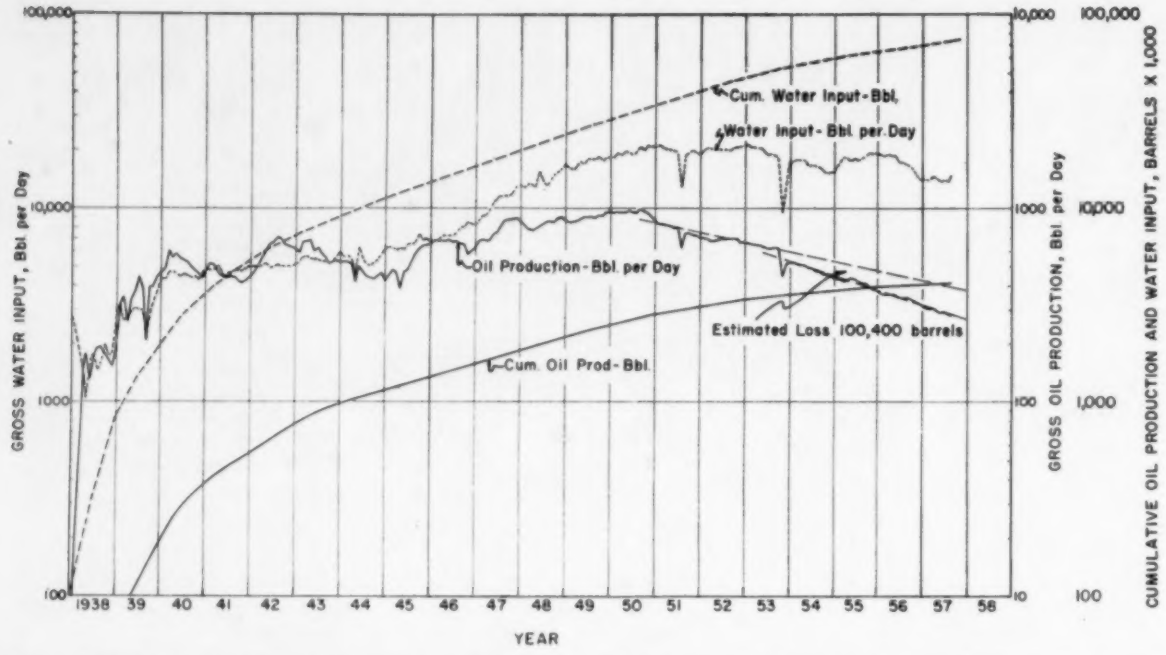

GROSS WATER INPUT, Bbl. per Day
GROSS OIL PRODUCTION, Bbl. per Day
CUMULATIVE OIL PRODUCTION AND WATER INPUT, BARRELS X 1,000
Cum. Water Input-Bbl.
Water Input-Bbl. per Day
Oil Production-Bbl. per Day
Estimated Loss 100,400 barrels
Cum. Oil Prod-Bbl.
YEAR
1938 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58

FIG. A. **Production and injection data** for 29 leases of Chanute Property Management Corporation, Inc., waterflood project in eastern Kansas, as presented by Paul D. Torrey in original article.

with the implication that high flooding rates (in contrast to low) would result in more water being introduced into the tight zones and that oil would be produced with lower water-oil ratios:

"If it were profitable to produce a well at a high water-oil ratio, just as much oil might be produced with low injection rates, but in actual practice such procedure usually will not be economical."

The implication contained in this statement is not correct, and, in fact, just the opposite is true. At low flow

OIL INDUSTRY PROGRESS... *powered with*

In the oil industry, the advent of high speed drilling, increased power, and greater efficiency of machinery presented challenging problems in power transmission. DIAMOND engineering service pioneered from the start . . . solving power transmission problems for the oil country with new concepts of roller chain design and use.

From the first roller chain application on a rig front powered by an internal combustion engine (1928) to the almost limitless variety of uses made possible by today's design, engineering and manufacturing skills, DIAMOND Chain Company has achieved many recorded "firsts" in the design and manufacture of finished steel roller chain. This record has extended over a period of more than sixty-eight years.

Whatever your power transmission problems, you can solve them more efficiently and more economically with DIAMOND Roller Chain.

DIAMOND CHAIN COMPANY, INC.
A Subsidiary of American Steel Foundries
Dept. 441, 402 Kentucky Avenue, Indianapolis 7, Indiana
Tulsa Office: 2238 Terwilleger Blvd.
Offices and Distributors in All Principal Cities
Please refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER.

DIAMOND ROLLER CHAINS

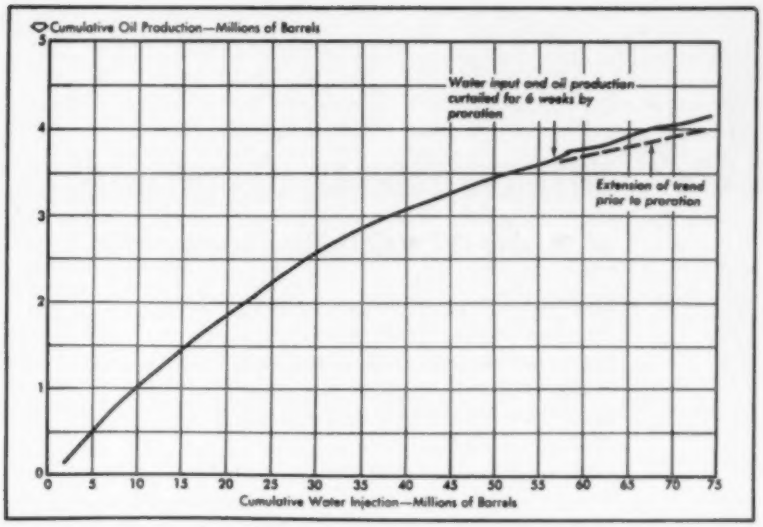

Cumulative Oil Production—Millions of Barrels
Water input and oil production curtailed for 6 weeks by proration
Extension of trend prior to proration
Cumulative Water Injection—Millions of Barrels
0
1
2
3
4
5
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

FIG. B. Relation between oil production and water injection for 29 leases of Chanute Property Management Corporation, Inc., waterflood project in eastern Kansas, as presented in article by Buckwalter, et al.

rates the capillary forces cause more effective interchange, and a greater fraction of the water enters the tight zones at low flooding rates than at high flooding rates. The oil expelled into the more permeable layers is produced at *lower* water-oil ratio than would occur at higher flooding rates. In some ranges of flooding rates, only very small increases in water-oil ratio will accompany increases in rate, because sufficient time for capillary interchange may exist at all the rates of interest. However, if there is not sufficient time for effective capillary interchange, the higher rates will result in higher water-oil ratios. Therefore, variations in permeability profiles do not cause premature abandonment at low rates because of high water-oil ratio.

Interpretation of History Of Eastern Kansas Project

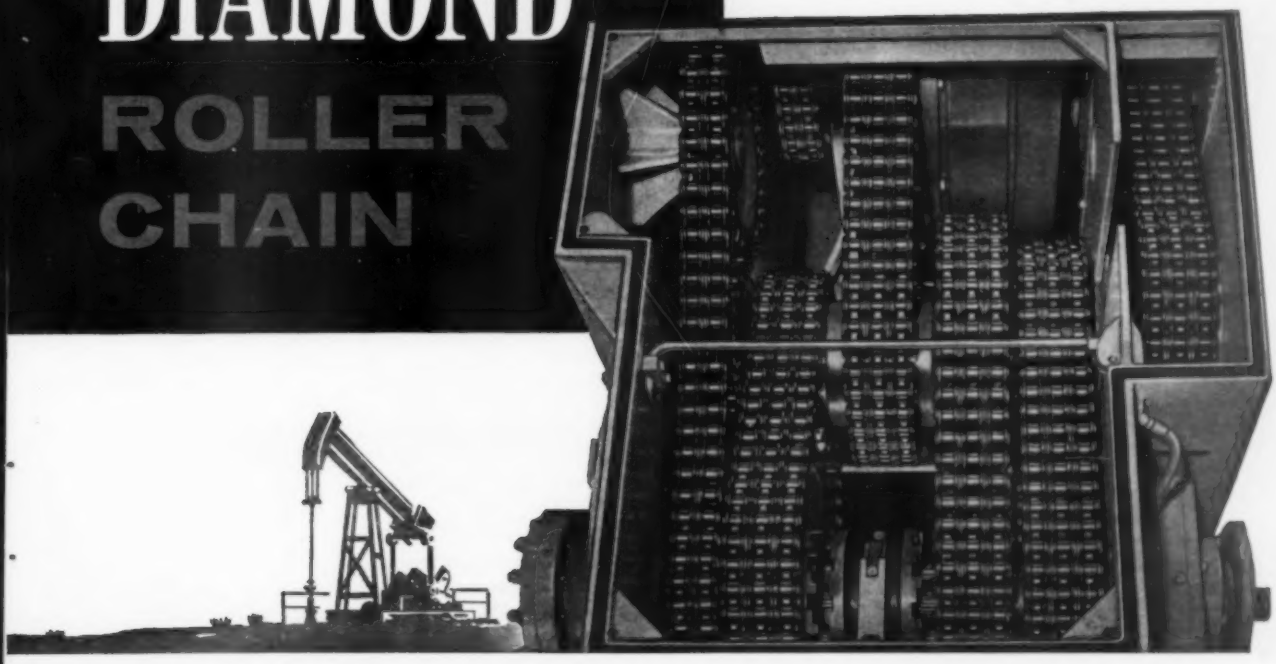
In reference to his Fig. 2 (Fig. A), Dr. Torrey concludes (p. B-72) that:

"... there has been a loss in production over a period of about four years of approximately 100,000 bbl of oil. This loss, very conceivably, could be temporary and might be regained if it should be possible to continue to produce the project for an extended period of time which will not be done, in all probability, because it will not be profitable to do so."

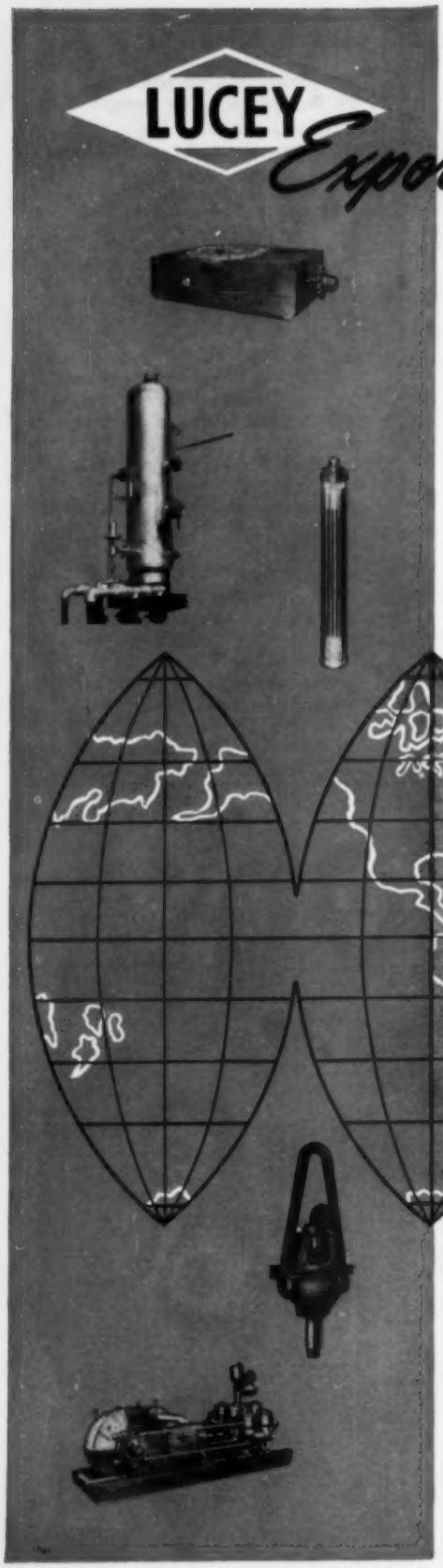
To consider whether or not it would be profitable to produce the project for an extended period of time, it is necessary to explore in more detail why the oil production during 1954-1957 was about 100,000 bbl less than would have been expected by extrapolation of the decline experienced during 1952-1953. Referring to Fig. A (Torrey's Fig. 2), it can be seen that the injection rate for a sustained period prior to October 1953, was about 20,000 bbl per day. After the six weeks' proration period in 1953, the injection rate averaged 16,000 to 17,000 bbl per day for about a year, an average of about 15 to 20 percent less than before proration.

It is not surprising that the oil production rate also dropped to a level about 15 to 20 percent below that prior

DIAMOND
ROLLER
CHAIN



FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



LUCEY *Export*

INTERNATIONAL DISTRIBUTORS

of Quality Oil Well Drilling Equipment

beck "melloblu" gas burners • byron jackson products
chain belt company sprocket & roller chain
hughes rock bits and tool joints • lucey boilers and insulation
casings • mission pistons, liners, and valves
parkersburg derricks, brakes, separators, and tanks
pittsburgh steel oil country tubular goods
reddaway brake blocks and linings • reed rock bits
and tool joints • security engineering products • thermactor electric
oil well heaters • totco drift and directional recorders
union wire rope and tuffy slings • wheland rotary drilling equipment
drilco oil tools, drill collars, reamers, stabilizers, subs
tube-kote corrosion kote, paraffin kote, plastic coatings

LUCEY *Export*

LUCEY EXPORT CORPORATION

233 Broadway, New York 7, New York
West Building, Houston, Texas
Broad Street House, London E.C. 2, England
Calle Defensa 320, Buenos Aires, Argentina
"Pretecca" Maracaibo & Anaco, Venezuela
Calgary and Edmonton, Alberta, Canada
Bay & C., Milan, Italy

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD

to proration. The injection rate increased in 1955-1956, but never to its previous rate, and throughout 1957 was maintained at about 14,000 bbl per day, the lowest sustained rate since 1948. Thus it can be concluded that the oil production rate decreased not from a six weeks' proration period but *simply because of decreased water injection rates.* If the injection rates were again increased, the oil production rate would also increase.

To determine if the overall efficiency of the flood was impaired by the six weeks' period or by the sustained reduction in injection rate, reference can be made to Fig. 7 of an article published by Buckwalter, Edgerton, Stiles, Earlougher, Buckles, and Bridges*. This figure, reproduced as Fig. B, refers to the identical properties as Torrey's Fig. 2 and shows cumulative oil production plotted as a function of cumulative water injection.

The slope of the curve is the number of barrels of oil produced as a result of a barrel of water injected. An increase in slope would indicate more oil produced per barrel of water injected; a decrease would indicate less oil produced for a barrel of water injected. The slope of the curve of Buckwalter, et al, shows that no impairment in efficiency resulted from the 1953 shutdown or subsequent reduction in injection rate. In fact, Buckwalter, et al, while not endorsing this conclusion, nevertheless did observe (see above reference):

"A comparison of the extrapolation with the actual curve would indicate that the curtailment had resulted in an increase in ultimate oil recovery."

Certainly, the figure of Buckwalter, et al, does not indicate an impairment of displacement efficiency.

From consideration of Torrey's figure and Buckwalter's, et al, figure, one can agree with Dr. Torrey that the loss in production could be temporary and might be regained. Further, one can conclude that no loss in recovery efficiency occurred as a result of decrease in production and injection rates, that the decrease in production rate resulted from decrease in injection rate, and therefore that an increase in injection rate would result in increase in oil production rate. By adjusting the injection rate, therefore, the oil production rate could be maintained at a sufficiently high value to insure continued profitable production. No loss in ultimate recovery would occur.

Migration of Oil

The protection of correlative rights is an important factor which must be considered in evaluating the effect of curtailment on the performance of water floods. In discussing the migration of oil during the flooding of pressure-depleted fields, Dr. Torrey points out that during flood developments the first projects must often be developed and operated adjacent to depleted leases of other operators and royalty owners.

He very aptly points out that injection operations will increase pressure in only the segment of the field under flood, and that fluids will migrate from the areas or leases under flood to the adjacent depleted areas or leases. He further points out that this will not necessarily reduce the ultimate recovery from the field as a whole but may result in loss of ultimate recovery on particular leases. Arguing that reduction in water injection rate does not *immediately* result in reduction in producing rates, but that a period of several months is required to establish a new equilibrium, he states (p. B-72):

"... an operator who chooses to initiate a flood in an otherwise depleted reservoir and cannot use the protection of line inputs, should not be advised that discontinuing or reducing water injection to curtail the peak of oil production will have no adverse effect on ultimate recovery from his particular lease. Furthermore, if the operator continues to inject water at the normal rate and at the same time is forced to curtail the production of oil, he can be faced with the danger of losing oil irretrievably to adjacent properties."

In this quotation, Dr. Torrey emphasizes the important point that it is the relation between injection and production and the associated pressures resulting in various parts of the reservoir which determines the amount of migration. If the wells in a flood in a depleted field are produced at capacity (i.e., bottom-hole pressure maintained at the same value as in the depleted area of the field), the amount of migration which will occur is independent of the injection rate. If the production rate is curtailed so that bottom-hole pressure increases, additional migration will occur; however, if the bottom-hole pressures at the producing wells in the flood area are maintained low while the injection rate is decreased, the oil production rate can be adjusted to any desired level with no more migration than would have been experienced in an uncurtailed flood.

Adjustment of the injection rates to provide the allowable oil production is thus an engineering problem which can be solved without migration and loss of more oil to adjacent properties than would occur with uncurtailed production. As much engineering planning is required to prevent migration in secondary waterflooding as in primary operations under natural water drive and gas-cap drive. Freedom from curtailment as a substitute for such engineering is not warranted either in secondary recovery or primary oil development operations.

Summary

In summary, the author agrees with Dr. Torrey's conclusion that equal or larger amounts of oil can most probably be recovered from curtailed floods over extended periods of time as from uncurtailed floods. Moreover, as explained herein, uncurtailed operations are neither necessary nor effective for prevention of migration and protection of correlative rights. The evidence in Dr. Torrey's article does not support his implication that curtailed floods cannot profitably be produced long enough to realize full recovery. While his statement that uncurtailed floods are usually more profitable than curtailed floods is true, this is no more a basis for uncurtailed production or allowables in secondary than in primary operations. ★ ★ ★

*"Water-Flood Oil Recovery Is Lessened by Restricting Rates," *Oil and Gas Journal*, June 16, 1958, p. 97.

Soviet Union Scientists Withdraw from World Congress

THE SOVIET UNION has cancelled its arrangements to send oil scientists to New York to attend the six-day Fifth World Petroleum Congress, opening May 31.

Notice of this change in plans came in a cable to C. E. Davis, the Congress general secretary, from Professor A. V. Topchiev, vice president of the Academy of Science, USSR.

Professor Topchiev is also chairman of the Soviet Union's Congress Committee, one of 36 established by professional institutions in as many countries to aid in the organization of the New York meeting.

In his cable Professor Topchiev complains that "conditions of a discriminatory nature" have been imposed on Soviet scientists who were to attend the Congress. This refers to the State Department's policy not to allow the scientists from the Soviet Union to visit certain areas in the United States unless reciprocal rights to United States oil men were granted by the Soviet Union.

The Department of State has been working on an exchange of petroleum technologists with the Soviet Union for the past year, but have recently been informed that the USSR is not interested in arranging such an exchange at this time. Without reciprocity from the Soviet Union the State Department is unwilling to open any areas now restricted for travel to Soviet citizens.

How you can tell it's

BUILT LIKE A MACK

If the trim, functional lines don't tell you . . . if you don't spot the famous Mack bulldog perched up in front . . . you can tell in other ways.

Take the attitude of the man at the wheel. He's proud to be driving the world's finest truck—the safest, sturdiest, best-handling job of its kind—and he doesn't mind letting you know it.

Note the business-like looks. No costly, useless passenger-car styling frills. And even older Mack trucks are a cinch to recognize—partly because of the sturdy construction that's a Mack trademark . . . partly because Mack users take extra pains to maintain their top earners in like-new condition.

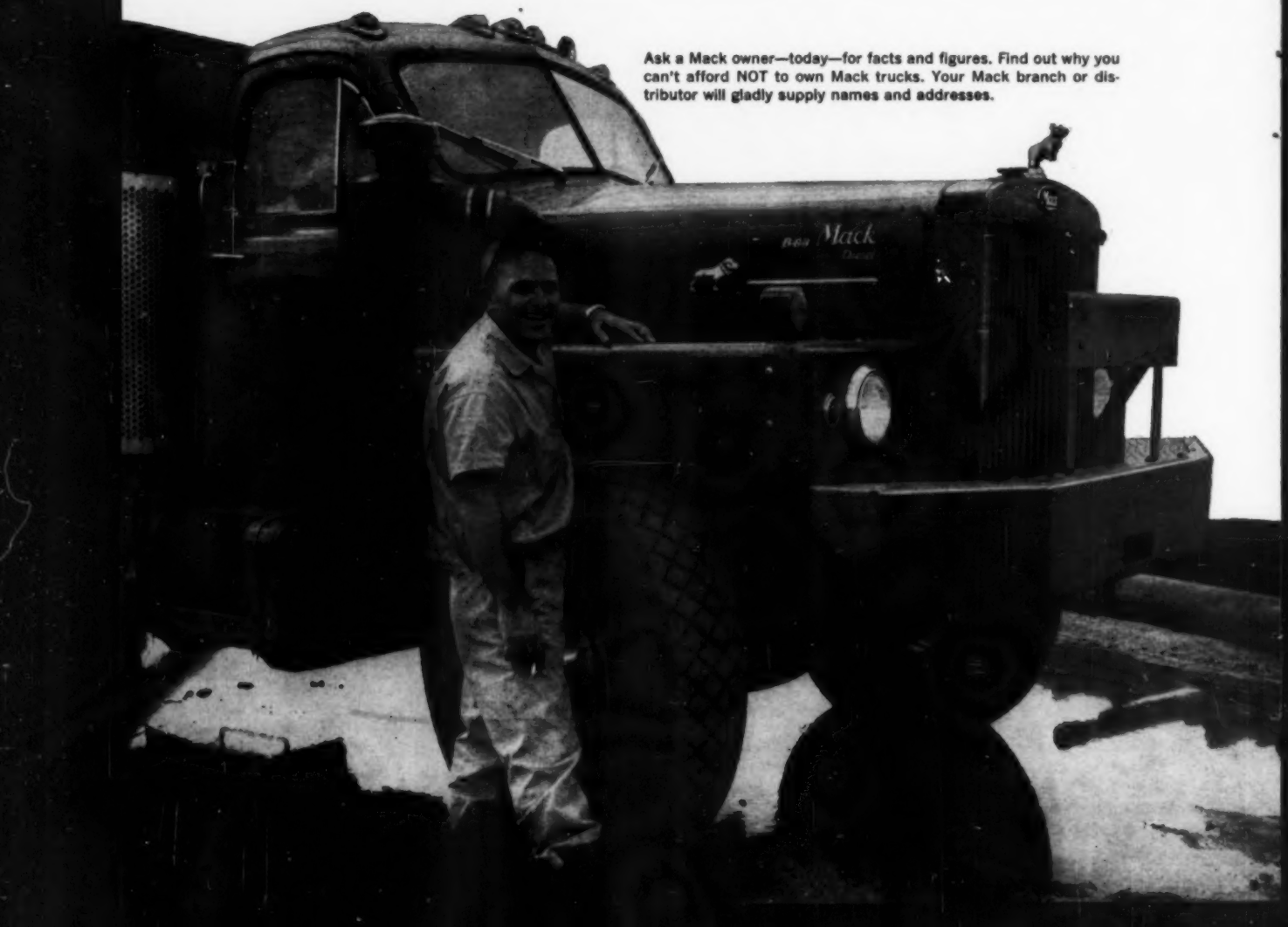
And consider the owner's name. A Mack operator is likely to be a successful operator. He knows from experience about the ruggedness and mechanical superiority of Mack-built engines, transmissions, frames and axles. He knows these factors pay off big—in earning power, in economy, in dependability and in mileage life that can't be equaled.

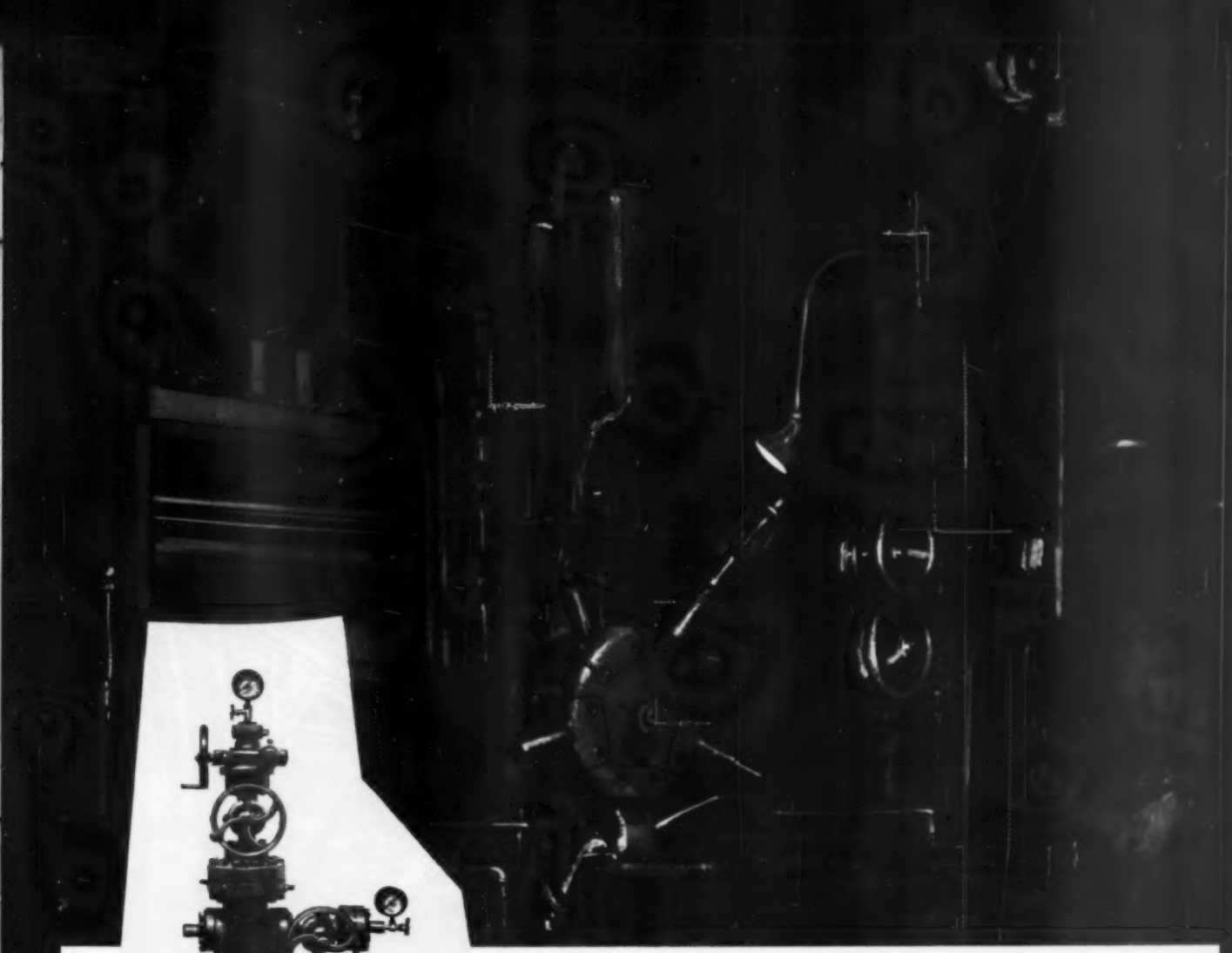
But the best way to know a Mack is to own a Mack! Why not find out for yourself, soon, why there are so many Mack trucks *to* recognize—on the highways . . . in oil-field service . . . in logging, mining and construction . . . and wherever important work's in progress. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

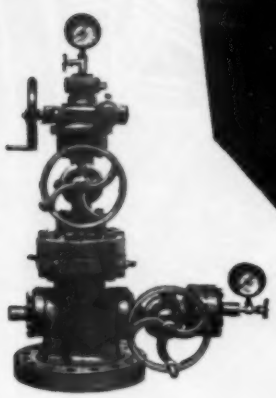
4813

MACK *first name for* **TRUCKS**

Ask a Mack owner—today—for facts and figures. Find out why you can't afford NOT to own Mack trucks. Your Mack branch or distributor will gladly supply names and addresses.







MACHINES THAT MEAN BUSINESS

Scores of fine craftsmen – and their machines – are constantly in evidence in the field.

Many of these men and their giant, complex, automatic cutting, boring and milling tools make their headquarters in the Houston plant of the Oil Center Tool Company. And their skill leaves an indelible imprint on every piece of O-C-T equipment. It is an imprint of quality.

Craftsmen and machine tools team up with our research and design engineers to produce wellhead components that are precision manufactured. And these components are in turn precision installed by highly qualified forces in the field.

Progress became a daily practice at O-C-T because of the skill of many—including many men and their machines. And these machines are the most modern, the most efficient that are available.

O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

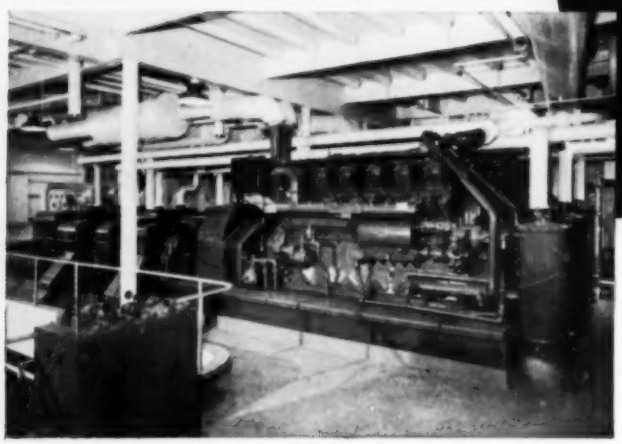
Address Export Inquiries for All Countries to
P. O. Box 3091, Houston, Texas.

where progress is a daily practice

READING & BATES Offshore Drilling Company

OFFSHORE DRILLING TENDERS

have WAUKESHA Turbocharged DIESELS



(above) Drilling tender J. W. Bates uses (left) three WAUKESHA Model VLRDBS Turbo-Supercharged DIESELS—12-cylinder, 60-degree vee, four cycle, 8½ x 8½-inch bore and stroke, 5788 cu. in. displacement, with counterbalanced crankshafts. Send for Bulletin 1663.

Reading & Bates Offshore Drilling Co., of New Orleans and Tulsa, have two drilling tenders, the *J. W. Bates* and *George M. Reading*—260′ long; 54′ wide; molded depth, at sides, 16′3″. The tenders operate offshore, one in the Gulf of Mexico, the other in the Gulf of Persia, at a distance of 40-75 miles. Both use Waukesha V-12 Turbocharged Diesels.

Pictured above are the tender *J. W. Bates;* and its three VLRDBS Waukesha V-12 Turbocharged Diesels driving the National Supply Company's largest mud pumps (No. 2-G-1000) through a three-section National gyrol compound with two-speed drive.

An official of Reading & Bates says, "The Waukesha V-12 Turbocharged Diesels, through their dependability and economical operation have earned the confidence and approval not only of the drilling crew personnel but of the entire Reading & Bates organization."

416

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN / **New York • Tulsa • Los Angeles**
Factories: Waukesha, Wisconsin and Clinton, Iowa

RUNNING TOUR

▸ Three new engineers to the Dallas staff of Stekoll Petroleum Company to handle increased international operations are: **J. R. Christian,** area exploitation engineer for Canada; **Otto Van Maerssen,** reservoir engineer; and **William Shannon,** mechanical engineer.

J. R. Christian

Christian came to Stekoll from 2 years with DeGolyer & McNaughton. Van Maerssen has worked for 6 years in Venezuela, and Shannon spent the past 2½ years working with Creole in Venezuela.

W. D. Shannon

O. Van Maerssen

▸ **T. D. Humphrey Jr.,** formerly a general partner of Thos. D. Humphrey & Sons, Ltd., announced the formation of a new exploration, producing, and drilling company with general offices located at 1313 Republic National Bank Building, Dallas, Texas. The new firm will operate its exploration and production activities under the name of T. D. Humphrey Jr., with emphasis on the East Texas area. Key personnel of the former organization associated with him includes **Morris A. Porter,** management assistant; **Arnold J. Nass,** land and engineering, and **S. L. Calhoun,** production superintendent.

Humphrey also continues in the drilling business, operating as Ace Drilling Company under the general supervision of **Gorman Webb,** with **James Wesson** and **Cecil Payne,** who have been with the firm since its organization in 1946, continuing as drilling superintendents.

▸ **Robert H. Parks** has opened offices as a consultant in petroleum engineering and geology in the Mid-States Building in Tulsa, Oklahoma. Parks has been employed for the past 10 years by Sunray Mid-Continent Oil Company and Texas Gulf Producing Company in various capacities as a petroleum and geological engineer. He will specialize in the preparation of evaluation reports and field studies for secondary recovery and pressure maintenance projects.

▸ **F. T. Elliott** has been promoted to superintendent of Continental Oil Company's North Texas-Panhandle production division. Formerly assistant division superintendent, he will continue to make his headquarters in Wichita Falls and will succeed **G. F. Beekman,** retired.

James E. Finley has been promoted to manager of exploration for Conoco's southwestern region. Formerly assistant southwestern region exploration manager, he continues his headquarters at Fort Worth and will succeed **D. D. Christner,** also retired.

A close Look at JENSEN'S Rotary JACK will show . . .

There IS a Big Difference!

Don't believe 'em when they tell you all pumping units are alike. Just take the New JENSEN Rotary JACK, for example: It has larger and heavier shafts and bearings; the unique rack-and-pinion counterbalance can be adjusted by one man — on the ground; it has floor clearing cranks and weights, installs on flat concrete surfaces or simple steel skids.

A four-cent stamp is all it takes to bring you complete facts and figures on the entire line of JENSEN JACKS. Do this before you equip that next well.

STOCKED BY YOUR LOCAL SUPPLY STORE

Made by JENSEN BROS. MFG. CO., INC., P.O. Box 477-B, Coffeyville, Kansas

Export Office: 250 Park Avenue, New York 17, N. Y.

JENSEN JACKS

HYCALOG V-DOOR DIAMOND DRILL BITS

PATENT PENDING

DRILLS 2814′ IN 13000′ WELL WITH ONE TRIP

In Kenedy County, Texas, a *single* Hycalog V-Door 6⅞" bit stayed on bottom from 10,186′ to 13,000′ T.D. Drilling time was 791.75 hours with an average rate of penetration of 3.55 ft./hr. Conventional bits drilling in this section could do no better than 3 ft./hr. and replacements were *frequent*.

You won't have to do much figuring to estimate the enormous savings in bit cost, in long round trips and rig time.

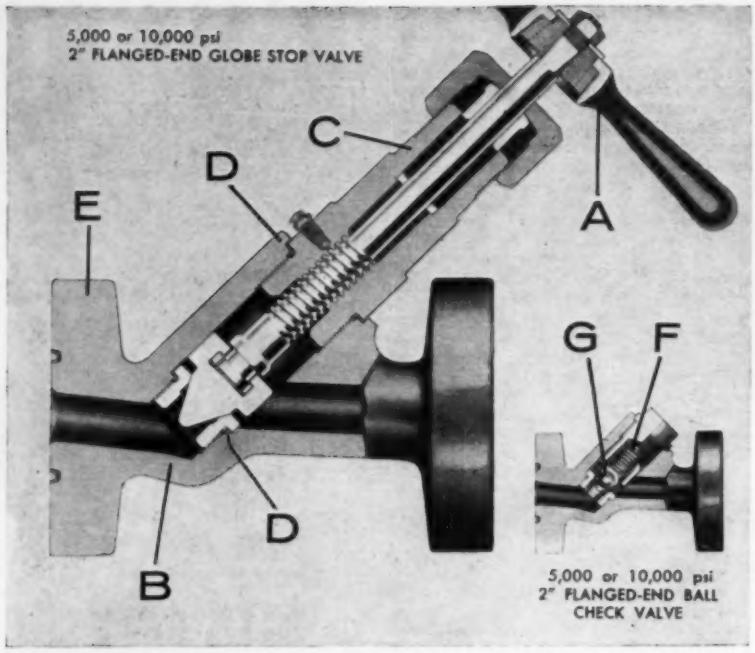
So, why not let us save you some big money on your next well with Hycalog V-Doors. *And don't forget* HYCALOG GAS CHRONOFRAC *well logging services.*

Hycalog, Inc.

505 AERO DRIVE
SHREVEPORT, LOUISIANA

BRANCH OFFICES IN PRINCIPAL OIL PRODUCING AREAS

DIAMOND BITS DIAMOND CORING
WELL LOGGING CORE ANALYSIS



New Edward High-pressure Valves for Petroleum Services

New high-pressure, *flanged-end* valves from Edward are designed to give you longer, more dependable service for many petroleum industry applications requiring highest quality in forged steel valves: high pressure heaters, treaters and separators, high-pressure vessel blow-down; headers and flow lines; bypass lines; unloading in compressor stations; blow-out preventer manifolds; throttling services; and many other similar petroleum industry applications.

NEW GLOBE STOP VALVES—There are two new Edward flanged-end, globe stop valves: one for pressures to 5,000 lb WOG at 300F (10,000 psi test); and one for pressure to 10,000 lb WOG at 300F (15,000 psi test). Both valves have the exclusive cross-arm style Impactor handle* (A) that makes closing against high pressure much easier, eliminates need for "cheaters." Valve body (B) is drop forged of chromium-molybdenum alloy steel to exacting requirements for maximum ruggedness and long life under toughest service conditions. The inclined bonnet (C) facilitates streamlining of flow passages, reduces pressure drop and wear-producing turbulence. Metal gaskets (D) and buna-N "O" rings assure tight, leak-proof fit between body and bonnet and between seat and body. Flanges (E) are forged integral with body and faced according to A.P.I. Standard 6B.

New globe stop valve Figs. 5138 and 9138

New ball check valve Figs. 5160 and 9160

NEW BALL CHECK VALVES—In the same pressure classes as the new stop valves, are two new forged-steel, ball check valves. These new check valves have the same general construction plus stainless steel spring (F) and 16% chromium stainless steel ball disk (G) for tight seating. Seat and ball disk are replaceable.

To get the complete story, plus ratings and dimensions, on new Edward flanged-end valves, write for Bulletin 584. Edward builds a complete line of cast and forged steel valves for pressures to 10,000 lbs, with flanged, screwed, socket, or butt welding ends. For additional information, see your favorite distributor, or write Edward Valves, Inc., 1220 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company.

*T.M. Reg. U.S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

Running Tour

▸ **Jack H. Ragsdale** has been elected a vice president of the Caran Engineering Corporation. Since his graduation from the University of Texas in 1951, Ragsdale has served as well logging manager for the South Texas-Gulf Coast district of the Caran companies.

J. H. Ragsdale

J. E. Pryor

▸ **James E. Pryor** has been employed by Delta Drilling Company as drilling superintendent of the West Texas-New Mexico division. He will headquarter in the division office in Odessa, Texas. He was formerly vice president in charge of drilling for Choya Drilling Company, Inc.

▸ Congressman **Frank Ikard** of Wichita Falls received the 1959 "Hats Off" recognition award given annually by Texas Independent Producers and Royalty Owners Association. **C. P. McGaha,** independent producer of Wichita Falls, presented the award and **J. E. Connally** of Abilene presided. Luncheon speaker was Under Secretary of Commerce **Frederick H. Mueller.** Other awards presented included a Service Recognition award given to **Gordon W. Johnson,** independent producer of San Antonio, for outstanding service as TIPRO's membership chairman. **Eugene M. Locke** of Dallas, retiring president, received the association's traditional plaque recognizing his service during the past year.

▸ **E. B. "Ed" Thompson** has been appointed manager of foreign trade, Standard Oil Company of California. He was manager of retail sales in Standard's Oakland division since 1941, and succeeds W. C. Lane who died suddenly of a heart attack December 31, 1958.

▸ **W. Blake Fox,** consulting geologist at Riverton, Wyoming, has announced his disassociation from the former consulting firm of Ford and Fox. Fox has established his own consulting practice, specializing in oil and uranium, with offices at 414 Spruce Street in Riverton.

▸ **Glenn M. Fedderson** has been named chief geologist for Murphy Corporation. Fedderson, who was employed in 1950 as a geologist in the company's Denver division, has been staff geologist since 1954.

▸ **Fred E. Smith,** vice president and manager of domestic production of The Ohio Oil Company, retired after 45 years with

F. E. Smith

G. F. Bish

the company. **Glenn F. Bish,** assistant manager, was elected vice president and manager to succeed him.

Running Tour

▸ **J. O. Brown,** vice president of Falcon Seaboard Drilling Company, was elected a director. Seven directors were re-elected.

They include **T. N. Law,** president of Falcon Seaboard since its founding in 1935; **C. W. Alcorn** and **J. L. Stauss,** both executive vice presidents; **Heywood Fox,** partner of Fox, Wells and Rogers; **William R. Hill Jr.,** vice president of Dillon, Read and Company, Inc., and **Joe M. Holliman** and **Robert A. Huffman,** partners in the law fism of Carlson, Lupardus, Matthews, Holliman and Huffman.

▸ **Walter L. Maguire** was elected president of Associated Oil & Gas Company. He moves to Houston from Stamford, Connecticut. Associated directors also elected **Robert E. Hornberger** of Dallas to the board.

▸ **H. T. Hunnewell,** formerly district engineer with Magnolia in charge of the Electra, Texas, district, is now associated with S & S Oil Company of Graham, Texas, as production manager and petroleum engineer.

▸ **Dr. Osvaldo Bracaccini,** former exploration manager of Y.P.F. from 1949 to 1955, has formed a partnership agreement with Harry Wassall and Associates to establish a branch office of this firm of consulting geologists in Buenos Aires, Argentina.

▸ The three presidents of Tennessee Gas Transmission Company's new operating divisions are: **W. C. McGee Jr.,** Tennessee Gas Pipeline Company; **R. C. Graham,** Tennessee Gas and Oil Company; and **R. R. Dean,** Bay Petroleum Company.

▸ **L. W. "Bill" Goudy** has been appointed as assistant exploration manager of The Vickers Petroleum Company, Inc. His new managerial responsibilities will be in addition to those of chief geologist.

▸ **Howard Dalton,** a geologist with Harry Wassall and Associates of Havana, Cuba, is on his way to Bolivia to take charge of a geological mapping party being contracted by Bolivian American Oil Company.

▸ **Gay V. Land** has joined the New York capital investment firm of Lambert & Co. as a general partner. Land is also becoming a general partner of an affiliated firm, Lambert Oil Exploration Company.

▸ New positions in Humble Oil & Refining Company's production department are: **L. H. Byrd,** operations manager, **J. O. Edwards,** administrative service manager; **Douglas Ragland,** engineering manager; and **Dr. C. R. Hocott,** research manager. **R. C Barbour** is the department manager.

▸ **John G. Walling** was elected controller and treasurer, succeeding **W. P. Roth,** resigned, as treasurer of Honolulu Oil Corporation. Roth, who has served as treasurer since 1930 and as a vice president since 1931, resigned both positions, but continues to serve as a director.

Walling has served as controller and assistant treasurer since 1958. **F. Dow Grant,** assistant to controller, was elected assistant treasurer.

A. G. Budge, H. W. Clark, L. A. Cranson, A. S. Donnelly, W. H. Kraft, A. C. Mattei, J. G. McIntosh, W. M. Roth, W. P. Roth, and **R. Sevier,** were re-elected directors.

Another plus value:

INHERENT LUBRICATING QUALITIES BROADEN USE OF SEECO-MUL AS E-P ADDITIVE

On your next well, try Seeco-Mul Drilling Mud Emulsifier as an extreme pressure additive. Many operators have recently discovered this extra advantage in Seeco-Mul; in fact we can show you data on a number of field wells drilled under almost identical conditions that will convince you that Seeco-Mul is the most effective E-P agent you can use.

The efficiency of Seeco-Mul as an E-P agent is due to its chemical structure—the ability of one end of the Seeco-Mul molecule to adhere tightly to a metal surface, attracting another molecule to form the familiar micelle, or the joining of two molecules at opposite ends. This layer attracts other Seeco-Mul molecules, which build up to an extremely tough lubricating film that is difficult to remove and will withstand high pressure, successfully reducing metal-to-metal contact and subsequent wear, or galling, of the bearing surfaces.[1]

In addition to the E-P qualities, you get many other advantages with Seeco-Mul. Inasmuch as Seeco-Mul is a chemical emulsifier with superior wetting abilities, it is often run in so-called "soap" drilling fluids (the addition of detergents to fresh water muds, oil-and-water, and water-clay systems) to lower the surface tension, thereby wetting the formation ahead of the bit and keeping the bit clean. Such systems also afford a faster penetration rate and aid the suspended solids to drop out in the pits.

Too, with good lubricating qualities in the mud, less drill stem torque is required, pump pressures can be lowered and more evenly sustained, and a higher velocity of the fluid on bottom can be obtained . . . all of which means longer service life for liners, collars, tool joints, drill pipe, and the bits themselves.

Add to this the longer bit runs and the consequent savings in bits and rig time and you will agree that adding Seeco-Mul to the system is an investment rather than a drilling expense.

Let us show you how you can use Seeco-Mul profitably. We'll gladly send you illustrated literature and a lab sample of Seeco-Mul, or contact your local mud dealer. You can get full particulars without obligation.

[1] *McCutcheon, John W., "Synthetic Detergents."*

Make a good mud better...use

CROSSETT **Seeco-Mul** **DRILLING MUD EMULSIFIER**

Manufactured by the Chemical Division of The Crossett Company, Crossett, Arkansas

Seeco-Mul is the dried flake form of a compound of the sodium salts of abietic, linoleic, and oleic acids, together with quantities of wood tannins and lignins.

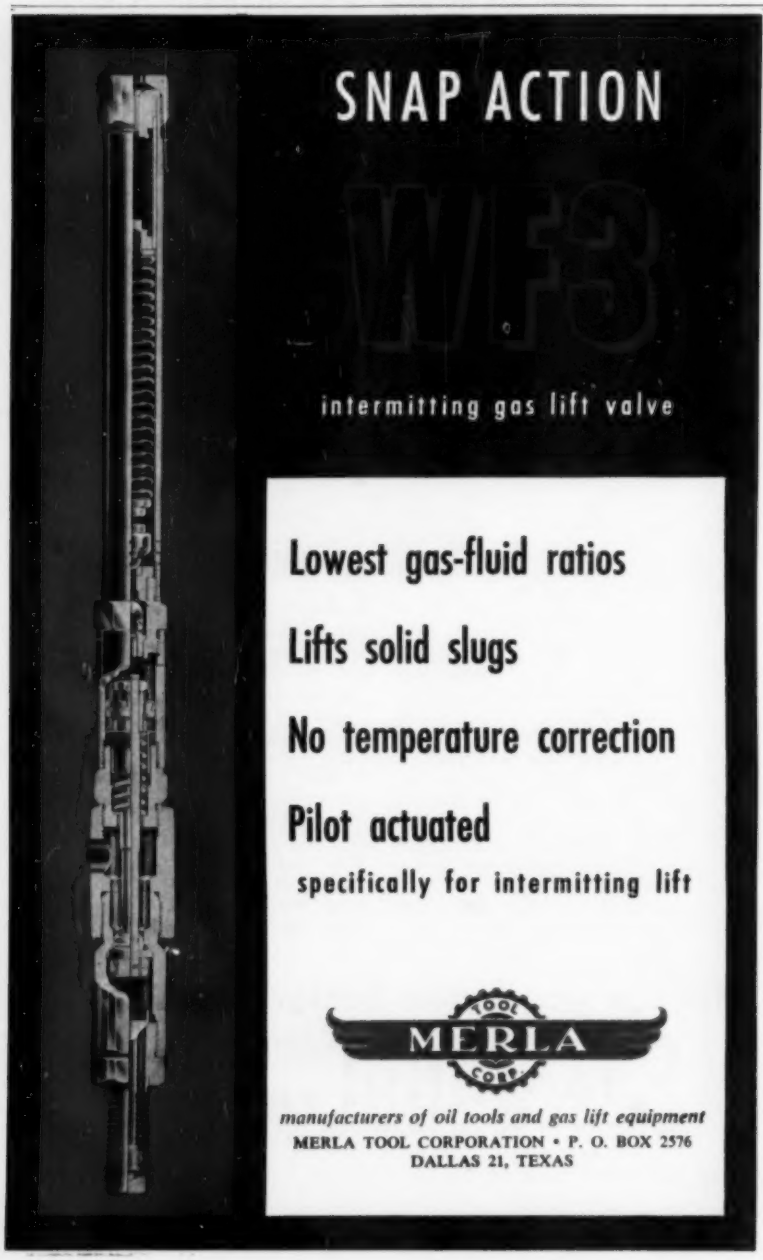
EXPLORATION ACTIVITIES

FLORIDA

Forty Mile Bend Draws Wildcat for Dade County

Commonwealth Oil Company and Coastal Petroleum Company have begun preparations for a rank wildcat in the Forty Mile Bend area of western Dade County. A canal and road are under construction toward the site of the No. 1 State 1005, Section 11 T54S-R35E. Current contract calls for a 11,500 ft test.

The new test is less than three miles from the Forty Mile Bend pool, abandoned in 1955. This field was opened by Commonwealth at its No. 1 Wiseheart-State 340, completed for 112 bbl of 21.7 deg oil and 331 bbl of salt water per day from the Sunniland lime at a depth of 13,220-39 ft. Gulf confirmed the discovery with a second well. Both were abandoned in September 1955 after producing 38,000 bbl of oil.



MISSISSIPPI

Discovery Indicated At Skelly Deep Test

Skelly Oil Company's No. 1-A Mississippi, in Section 1, T1ON-R18W, is drilling ahead after recovering a good oil showing at 8104-24 ft, believed to be in the Eutaw. Cores at 8148-98 ft substantiated the call.

The well will be drilled to 14,800 ft in the Hosston formation. Dry hole support has been pledged by Pan American Petroleum Corporation, which owns adjacent acreage. The wildcat is three miles from the Magee pool of Simpson County, in the south central part of the state.

LOUISIANA

Pan American Test To Probe Little Chenier Area

Pan American Petroleum Corporation has staked location for a projected 10,500-ft South Louisiana wildcat in the Little Chenier area, five miles northwest of Grand Chenier field in Cameron Parish.

Pan American's No. 1 Mermentau Mineral and Land Company is due southwest of Catfish Lake, in an area of deep marshland. There is no current production in the vicinity. Operator has a fee tract of some 7500 acres to the east of the wellsite, which is spotted 2460 ft west and 660 ft south of the northeast corner of Section 20-T14S-R5W in Cameron Parish. Pan American has 100 percent interest in the projected operation.

COLORADO

Lion's Four Corners Test Finds Oil in Ismay, Bluff

Lion Oil Division of Monsanto Chemical Company has announced the completion of a wildcat discovery well in the Paradox Basin area of Montezuma County, Colorado.

The Retherford No. 1 is located on a 1800-acre block which is owned jointly with Gulf Oil Corporation. The well was drilled to a total depth of 6090 ft and flowed 812 bbl of 42 deg oil per day through a ½-in. choke from perforations in the Bluff sand. Also, 192 bbl of oil per day were produced through a ⅝-in. choke from perforations in the Ismay sand.

The discovery is about 9 miles north of Towaoc, Colorado. In addition to a one-half interest in the 1800-acre block, Monsanto has approximately 1300 net leasehold acres in the immediate vicinity.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

ONTARIO

Imperial Encounters 'Show' In Lake Erie Explorer

Imperial Oil confirmed that one of its exploratory wells in southwestern Ontario has encountered an encouraging show of oil. Imperial Harvest Submarine Colchester South 1-76 is located on the shore of Lake Erie near the town of Colchester in the Windsor area. It is being drilled in partnership with Harvest Petroleums Ltd., and Submarine Oil and Gas Ltd. The well to date has penetrated 17 ft of gross pay zone and is currently testing at 2165 ft.

USSR

Russians Extend Drilling Deeper Into Caspian Sea

Russia has high hopes for increased offshore oil production from a northeast extension of the Neftyaniye Kamny (Oil Rocks) field in the Caspian Sea about 62 miles east of Baku.

Soviet reports say recent exploration of Neftyaniye Kamny's northeastern fold has proved "very promising." First platform in the sector is now under construction in water 82 ft deep. As more platforms are built they will be connected by steel trestles carrying a narrow-gage railroad.

ALASKA

General Pete Preparing Bristol Bay Explorer

General Petroleum Corporation is making preparations for moving in equipment to commence the drilling of an exploratory well on lands near Bristol Bay, Alaska, which are included within a 455,000-acre development contract approved on March 18 by the Secretary of the Interior.

Rig and camp facilities that were used to drill Humble Oil Company's Bear Creek No. 1 will be moved to the Bristol Bay area for General Petroleum's exploratory well. Rowan Drilling Company has the contract.

"Certainly you've heard of oil recovery by field pressurizing?

Oakite ECP
engineered cleaning program

speeds up cleaning of

power slips hooks
catheads spiders

with the new Oakite "HURRICLEAN.®" Steam-Detergent Gun

On big, heavy drilling equipment like power units, elevators and pumps, Oakite *ECP* comes up with the perfect tool for fast cleaning—the new Oakite Hurriclean Steam-Detergent Gun, spiked with the proper Oakite cleaning solution.

Try this gun on the dirtiest rig around. See how it reaches up, under, around and into the hard-to-get-at places with powerhouse impact, ripping off grease, sludge, mud and muck. So fast that just a few minutes with this gun is worth hours and hours of swabbing with brush and bucket.

What's more, it's the nicest gun you ever handled. Weighs only 6¼ lbs. Stays cool to the touch, with the steam confined to an *inner* insulated tube. Changes spray direction when you twist the tube grip, so there's no dragging and kinking of hose.

Oakite ECP is the Engineered Cleaning Program that brings you the advantages of modern mechanized, chemical cleaning. The Oakite Engineer furnishes on-the-spot assistance backed by laboratory research, specialized cleaning materials and time-saving methods. For more information, write to Oakite Products, Inc., 48 Rector Street, New York 6, N. Y.

Export Division
Cable Address: Oakite

OAKITE
50 1909-1959 SCIENCE
years' leadership in industrial cleaning

Technical Service Representatives in Principal Cities of U. S. and Canada

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD B-141

USE HERCULES

equipment to
produce MORE oil
at LESS cost

HERCULES TYPE SOS

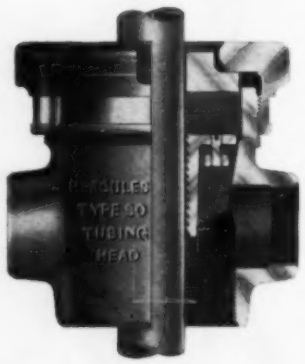
TUBING HEAD

Hercules "Type SOS" is a 4000 pound test stripper tubing head. The lower section contains the neoprene tubing stripper; the upper section or bowl contains the slips and packing arrangement. The SOS is unsurpassed for use in well servicing operations in addition to its use in flowing wells.

HERCULES TYPE SO

TUBING HEAD

Hercules "Type SO" tubing head is actually the lower section of the "Type SOS" tubing head, containing the slips and packing arrangement. It is particularly suitable for pumping due to its compactness, being approximately 12 inches high.



HERCULES Products are
sold through All Supply Stores

HERCULES TOOL COMPANY

Manufacturers of Oil Field Equipment

GENERAL OFFICES AND PLANT • TULSA, OKLAHOMA

Export Representative Oil Field Equipment Co., Inc. 90 West Street, New York, N. Y.

Exploration

TEXAS

Tennessee Gas & Oil Final Three Successful 'Cats

Three wildcat discoveries in Texas – two oil wells and a gas well — were announced by Tennessee Gas and Oil Company, a division of Tennessee Gas Transmission Company.

The two oil discoveries are in Throckmorton County, with one of them having indicated production from three zones. It is the No. 1 Brown, in the Bradley Garner Survey about two miles northeast of the Liles field. On a production test, it flowed at the rate of 217 bbl per day from the Mississippian lime at a depth of 4639 ft. On drillstem tests, 2030 ft of oil and no water were recovered from the Caddo lime at 4154-77 ft and 965 ft of oil and 97 ft of heavily oil and gas cut mud were recovered from the Strawn sand at 3058-66 ft.

The second Throckmorton well is the No. 1-A Massey, which flowed at the rate of 120 bbl per day during a drillstem test of the Atoka Conglomerate at 4633-43 ft. The well is in Section 1637 of the TE&L Survey, about 10 miles southwest of the town of Throckmorton.

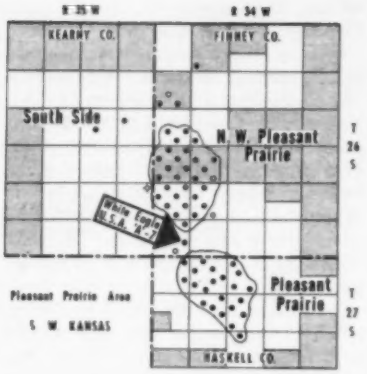
The gas discovery, the No. 1 Wilfert, is in Jefferson County, about 2½ miles southeast of the Fannett field. From perforations at 8006-11 ft, it tested at an absolute open flow of 11,000,000 cu ft of gas per day, with 12 bbl of condensate per MMcf.

Trice Begins Two Tests For Jack County Oil

Trice Production Company has spudded a shallow confirmation test and has begun a wildcat, both in Jack County.

Trice's No. 1 D. Lindsey, spudded early in April, is a 3600-ft test to confirm the Fain & McGaha Lindsey lease 10 miles north of Jacksboro in the Jack County regular field (a county-wide designation of shallow sands). An oil prospect, the No. 1 Lindsey is being drilled by Strawn Drilling Company. The operator has leases on about 169 acres in the area.

Three and one-half miles northeast of the town of Jermyn in northwest Jack County, Trice has staked location for the No. 1 Vera Roney, a wildcat spotted a mile southeast of the Harwell Strawn field and one and one-half miles north of the North Wolf Upper Strawn and Caddo field. Projected to 5000 ft, the No. 1 Vera Roney is in an area of multiple Strawn sand and lime and Bend Conglomerate production. Trice has about 438 acres in the well site vicinity. Graytex Drilling Company is contractor.



KANSAS

White Eagle Drills Pool Joiner

With the completion of its forty-first producing well in the Pleasant Prairie area in Southwestern Kansas, White Eagle Oil Company has linked two producing areas into one common oil field. The Pleasant Prairie Pool, discovered by White Eagle in 1954, has now been connected with the Northwest Pleasant Prairie Pool, opened by the company in 1956. The linking well is the White Eagle "A" No. 7 U.S.A. in Section 31-T26S-R34W, Finney County. Total depth is 5235 ft. After treatment with 1000 gal of acid the well swabbed 70 bbl per hour for four hours after recovering the acid load. The well is now waiting on potential test.

White Eagle has had two drilling rigs steadily employed in the Pleasant Prairie area for the last 8 months. Production comes from the Mississippian formation (about 5100 ft) lying beneath the Hugoton gas pay which blankets White Eagle's 25,000-acre block. In addition to the Mississippian oil zone, some wells have been dually completed by the company in the Morrow sand and in other wells the Kansas City-Lansing is productive.

OKLAHOMA

Ambassador Make Oil, Gas Discoveries

Ambassador Oil Corporation has logged two discoveries in Oklahoma — one an oil producer, the No. 1 Krone in Cimarron County, and the other a gas producer, the No. 1 Davenport in Haskell County. The No. 1 Krone is located in Section 30-T4N-R9E CM, 21 miles east of Boise City. Production is from the Middle Morrow sand from perforations at 4475-80 ft and 4484-91 ft. The well swabbed 15 bbl of natural oil per hour for nine hours, or at the rate of 360 bbl per day. Pump and storage equipment are being installed. A west offset, Ambassador No. 1 Krone "A", is starting.

The No. 1 Davenport is located in Section 33-T8N-R20E, 34 miles northeast of McAlester. The producing zone is Atoka sand perforated from 5542-46 ft and 5550-70 ft. After treatment the well's open flow potential was estimated at 3,600,000 cu ft of gas per day. The discovery is on a block of approximately 35,000 gross acres acquired by purchase and farmout from Superior Oil Company. Ambassador operates the block in association with Hudson Gas and Oil Corporation, Keating Drilling Company and Republic Natural Gas Company, each company owning a 25 percent interest. A second well is planned immediately.

LIBYA

Esso Libya Prospector Flows 100 Bbl Hourly on DST

Standard Oil Company (New Jersey) announced that it has been advised by its Libyan affiliate, Esso Libya, that its Zelten No. 1 well flowed approximately 100 bbl an hour of 37 deg oil on a drillstem test at a depth of approximately 5400 ft.

This well is located in the Cyrenaica area on Esso concession No. 6 and is about 100 miles from the Mediterranean Coast and 200 miles south of Benghazi, Jersey Standard said. It is currently being drilled to greater depth.

ROCKFORD
OIL FIELD TYPE
Heavy-Duty
LONG LIFE
POWER TAKE-OFF
Provides a Choice of Clutch Types
ROCKFORD Oil Field type POWER TAKE-OFFS are furnished with single or double plate, gear tooth drive clutches—with organic or Morlife® cerametalic friction material. A single plate Morlife clutch provides the torque capacity of a double plate organic lined clutch. Morlife's 400% longer life and 50% better heat disbursal also increase the efficiency of oil field equipment.
SEND FOR THIS HANDY BULLETIN
Gives dimensions, capacity tables and complete specifications. Suggests typical applications.
ROCKFORD Clutch Division BORG-WARNER
1303 Eighteenth Ave., Rockford, Ill., U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.
Small Spring Loaded
Heavy Duty Spring Loaded
Oil or Dry Multiple Disc
Heavy Duty Over Center
Power Take-Offs
Speed Reducers
CLUTCHES

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

What's doing in DRILLING

Southeastern Drilling Gets 1000-Well Argentine Contract

W. P. Clements, Jr., president of Southeastern Drilling Corporation, Dallas, has described a new contract with YPF in Argentina as being the largest drilling contract ever signed. It calls for the company to drill 1000 wells in three years for a gross total of approximately $50,000,000. At the end of three years, the contract will be subject to renewal under identical terms for another 1000 wells.

Southeastern's Argentine subsidiary will drill the wells on the southern flank of Comodoro Rivadavia area, approximately 1200 miles south of Buenos Aires near the Atlantic Coast. The wells will average approximately 5000 ft in depth and are in a proved development area. Southeastern will use 20 new rigs in the program and will send 150 U. S. personnel to Argentina.

World's Second Deepest Test Temporarily Abandoned

Shell Oil Company has temporarily abandoned its No. 5 Rumberger, world's second deepest test and Oklahoma's record depth venture, at 24,-002 ft. The wildcat is located in the Elk City field of Beckham County. Shell has left tubing and casing in the hole, hoping that "some future scientific developments may stimulate production in zones which are now too tight."

Casing in the hole includes a string of 7-in. set at 20,505 ft, and a string of 9⅝-in. run to 11,505 ft, the longest string of this size ever run.

Cost of the dry hole amounted to more than $2,000,000, due to such complications as extreme operating temperatures, use of diamond bits and a $20,000 conversion from water to oil-based mud.

Kerr-McGee to Drill 500 Wells in Argentina

Contracts to drill 500 wells in the Comodoro Rivadavia of Argentina have been awarded to Kerr-McGee Oil Industries, Inc. by YPF, the Argentine oil monopoly. Frank C. Love, vice president of the Oklahoma City firm, has been in Buenos Aires concluding details of the program. Details of the project will be announced upon his return.

Kermac is presently doing contract work in Argentina for the L. R. Development Company, Ltd., under the name of Kermac Drilling Company of Venezuela, C. A. It is operating five company-owned rigs and two completion rigs owned by L. R. Development. Grier D. Zimmerman is manager of the Argentine company.

Union Producing Christens New Barge

One of the most modern offshore mobile drilling platforms, Union Producing Company's drilling barge "A," has been commissioned at Todd Shipyards Corporation's Houston plant. The barge, as tall as a 25-story office building when its drilling mast is raised, will be put to work drilling a development well on a lease in Eugene Island Block 116, off St. Mary's Parish, Louisiana.

The barge can operate in water up to 70 ft deep and is equipped to drill to depths in excess of 20,000 ft. The unit consists of a barge-type hull connected by 10 support columns to a fixed

elevated deck 80 ft above the hull. Four large caissons support the lower hull which measures 190 ft by 160 ft. The diesel-electric drilling rig mounted on the barge is owned by Rimrock Tidelands, Inc., who will be in charge of drilling operations. Operating base will be at Morgan City, Louisiana.

Contract Let for Costa Rican Venture

Drilling and Exploration Company, Inc., Dallas, Texas, has recently been awarded a drilling contract by Compania Petrolera de Costa Rica, Limitada, a partially owned subsidiary of the Union Oil Company of California, under the terms of which Drilexco is to furnish supervision and technical assistance for the drilling of several exploratory wells in the Republic of Costa Rica. The first well, a 15,000-ft test, is to be drilled only a few miles from Puerto Limon, and is readily accessible by railroad and highway.

Gulf Sells Interests In Citronelle Field

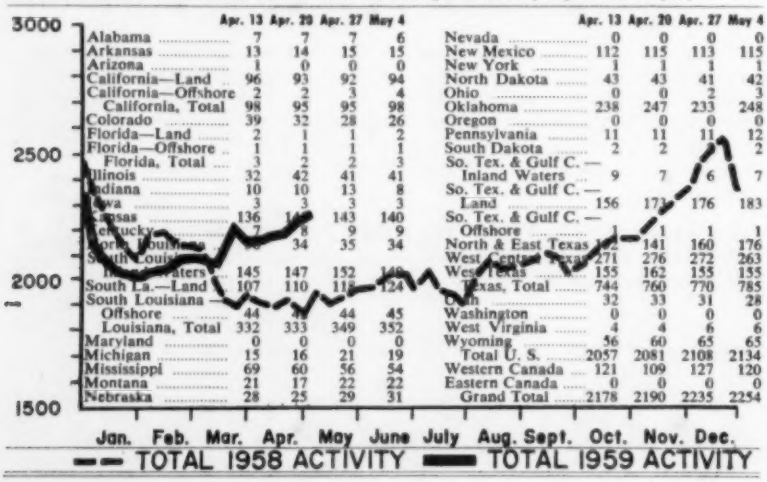
The sale of Gulf Oil Corporation's interest in the Citronelle field near Mobile, Alabama, to G. H. Jett, owner of Jett Drilling Company, Shreveport, Louisiana, and Bart B. Chamberlain, Jr., Mobile attorney and businessman, has been completed. The agreement transfers all of Gulf's present leasehold interests to a depth of approxi-

Rotary Rigs Operating in Oil Fields of United States and Canada

As reported to American Association of Oilwell Drilling Contractors by Hughes Tool Company.

	Apr. 13	Apr. 20	Apr. 27	May 4
Alabama	7	7	7	6
Arkansas	13	14	15	15
Arizona	1	0	0	0
California—Land	96	93	92	94
California—Offshore	2	2	3	4
California, Total	98	95	95	98
Colorado	39	32	28	26
Florida—Land	2	1	1	2
Florida—Offshore	1	1	1	1
Florida, Total	3	2	2	3
Illinois	32	42	41	41
Indiana	10	10	13	8
Iowa	3	3	3	3
Kansas	136	142	143	140
Kentucky	7	8	9	9
North Louisiana	33	34	35	34
South Louisiana				
Inland Waters	145	147	152	149
South La.—Land	107	110	118	124
South Louisiana — Offshore	44	43	44	45
Louisiana, Total	332	333	349	352
Maryland	0	0	0	0
Michigan	15	16	21	19
Mississippi	69	60	56	54
Montana	21	17	22	22
Nebraska	28	25	29	31

	Apr. 13	Apr. 20	Apr. 27	May 4
Nevada	0	0	0	0
New Mexico	112	115	113	115
New York	1	1	1	1
North Dakota	43	43	41	42
Ohio	0	0	2	3
Oklahoma	238	247	233	248
Oregon	0	0	0	0
Pennsylvania	11	11	11	12
South Dakota	2	2		2
So. Tex. & Gulf C. — Inland Waters	9	7	6	7
So. Tex. & Gulf C. — Land	156	173	176	183
So. Tex. & Gulf C. — Offshore	1	1	1	1
North & East Texas	140	141	160	176
West Central Texas	271	276	272	263
West Texas	155	162	155	155
Texas, Total	744	760	770	785
Utah	32	33	31	28
Washington	0	0	0	0
West Virginia	4	4	6	6
Wyoming	56	60	65	65
Total U. S.	2057	2081	2108	2134
Western Canada	121	109	127	120
Eastern Canada	0	0	0	0
Grand Total	2178	2190	2235	2254



mately 12,000 ft in Townships 1 and 2 North, Ranges 2 and 3 West, Mobile County, Alabama, and certain acreage in Washington County to the new owners. Included in the sale is all of Gulf's presently owned production and equipment now in use in the Citronelle field, including field pumping units.

Union Oil to Drill Far North, Far South

Union Oil Company of California will extend its program of foreign exploratory drilling this summer to operation of rigs near the edges of both the Arctic and Antarctic Circles.

A rig is being assembled for shipment to Argentina where operations are expected to start not later than September 1 in Union's large contract acreage in the Comodoro Rivadavia area, approximately 1000 miles southwest of Buenos Aires.

On the Kenai Peninsula of Alaska, Union will be operator of a joint test with Ohio Oil Company as quickly as road bans are removed and drilling equipment can be moved into the site. Total land holdings in this area exceed 40,000 acres.

Zapata Petroleum Disposes Of Offshore Equipment

Directors of Zapata Petroleum Corporation, Midland, have voted to dispose of the company's investment in Zapata Off-Shore Company stock. In addition, the board has decided to sell the five land drilling rigs and related equipment owned by the company's subsidiary, Zapata Drilling Company. Zapata Off-Shore owns and operates the barges Scorpion and Vinegarroon and the drilling tender Nola 1.

J. Hugh Liedtke, president of Zapata Petroleum, said that the long-term interest of his company would best be served by withdrawing from the drilling business and by the concentration of efforts in oil and gas exploration, purchase of producing properties, and production operations.

Glasscock-Tidelands Changes Name

Stockholders of C. G. Glasscock-Tidelands Oil Company have voted to change the name of the firm to Diversa, Inc., and to acquire from the Murmanill Corporation controlling stock interest in several companies which will become operating subsidiaries. Spokesmen said the new name suggests the company's present and contemplated diversified operations.

Murmanill Corporation remains the holding company. Besides the new acquisitions Diversa owns substantial oil and gas interests in several states and Canada, a shipyard in Corpus Christi, and drilling contracts in Mexico, South America, and Africa.

NEW WELL LOGGING PACKAGE CUTS COSTS... PROVIDES EXTRA INFORMATION

HYCALOG

CONTINUING RESEARCH FOR LOWER COST EXPLORATION

Continuous chromatographic monitoring and analysis of gas shows . . . *along with recording of principal drilling functions* . . . are combined in Hycalog's new GR-FDR package. And automatic operation permits the use of this equipment with *only one* attendant.

The package includes *two complete recording networks* . . . HYCALOG GAS CHRONOFRAC and a hot wire detector. One monitors methane content of mud gas samples and analyzes shows; the other records total combustible gases.

Added to this is the MARTIN-DECKER recording network which automatically measures and records the following drilling functions: weight on bit, pit level, pump pressure, and pump speed. (Recording of other functions such as torque and rotary speed are optional).

A *single* operator compiles and forwards daily all recorded data along with the log of any shows encountered.

With the new GR-FDR package you are sure of getting *round-the-clock* information at a cost far below regular well logging service.

Write for facts on the GR-FDR package. *And, while you're at it, ask about* HYCALOG V-DOOR *diamond drill bits.*

Hycalog, Inc.

505 AERO DRIVE
SHREVEPORT, LOUISIANA

BRANCH OFFICES IN PRINCIPAL OIL PRODUCING AREAS

DIAMOND CORING • DIAMOND BITS • WELL LOGGING • CORE ANALYSIS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

B-145

This is our "Fifth-of-a-Century" of superior service to the oil industry. GEOLOGRAPH recorders give you the most complete record available while the well is drilling. GEOLOGRAPH service is just as superior as the famous GEOLOGRAPH recorder! In all ways, it always pays to log as you drill with the GEOLOGRAPH recorder.

GEOLOGRAPH recorders combine exclusive, unique "Trip Action" and "Magna-Sensor" features.

For information, contact your local GEOLOGRAPH office.

GEOLOGRAPH®
OIL FIELD SERVICES
P. O. Box 1276 • Oklahoma City 1, Okla.

Ralph Collins Chosen to Lead Rocky Mountain API District

Ralph W. Collins, Midwest Oil Corporation, Denver, Colorado, was elected district chairman at the Rocky Mountain District Meeting of the API Division of Production. Collins succeeds C. J. Christensen of Pan American Petroleum Corporation, Calgary, Alberta.

J. M. Bunce, Mud Control Laboratories, Casper, Wyoming, was elected secretary-treasurer, succeeding W. A. McCullough, of McCullough Tool, Casper.

Vice chairmen elected were: For Wyoming — Freeman Egolf, Phillips Petroleum, Casper; For Colorado — R. L. Manning, R. L. Manning Company, Denver; For North Dakota — Roy Fuller, Amerada Petroleum, Williston, N. D.; For Nebraska — F. C. Aldrich, Ohio Oil, Sidney; For Montana — J. Roy Dorrough, Carter Oil, Billings; For Utah — Clayton Johnson, Equity Oil, Salt Lake City; For Canada — Claude Peavy, Britalta Petroleum, Ltd., Calgary, Alberta.

At a luncheon session, L. E. Fitzjarrald, manager of the production department, Phillips Petroleum, Bartlesville, Oklahoma, and API vice president for production, discussed "Ways and Means of Achieving Economy in Drilling and Production Operations."

Fritzjarrald also presented API "Citations for Service" to Wayne Glenn, Continental Oil, formerly of Denver, now of Houston, Texas, and C. J. Christensen, Pan American Petroleum, Calgary.

Among the many topics to be discussed at the committee sessions were supervisory development, secondary recovery, drilling fluids, straight-hole drilling, electrification and automation, blowout-preventer installation, jet-bit drilling and hydraulics, slim-hole drilling, well stimulation, vocational training, and drilling and production practices.

REELS

EHS-1520

EH-1816
with Type C
Measure Meter

Drillers and Producers Choose . . .

Mathey Measuring Line Reels for bottom hole pressures, temperature surveys, calipering, paraffin cutting, sampling and many other wire line jobs. Mathey Reels are made to meet your requirements of line speed, pull, capacity and type of power. Mathey's years of experience guarantee you heavy duty construction, precision machining, oversize bearings and forged steel drum flanges. Specialty reels can be engineered and manufactured. Call or write for further information.

SOLD THROUGH YOUR FAVORITE SUPPLY STORE

C. A. **Mathey** MACHINE WORKS, INC.
212 So. Frankfort • Tulsa, Okla. • Box 1159 • Gibson 7-3311

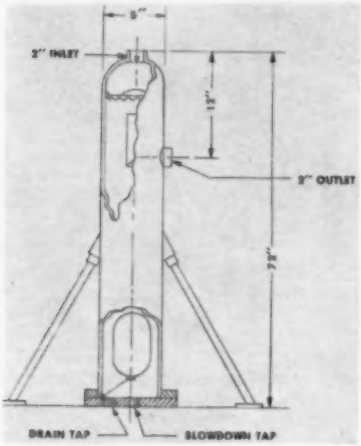
FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

It's New

Drilling – Producing Equipment

Separator for Small Low-Pressure Wells

The V. D. Anderson Company has developed a vertical gas-oil separator for use with small, low-pressure wells to separate oil and water from natural gas. Called the Hi-eF Type LGV2-600 model, this unit has an operating range from 0 to 600 psig pressure. The only moving

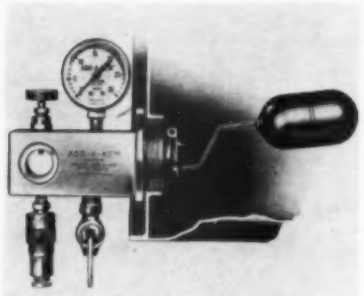


part is a float assembly which can be changed in a few minutes in the field at low cost if replacement is needed. The gas scrubbers are code stamped to the ASME Code for Unfired Pressure Vessels. *The V. D. Anderson Company.*

Circle number (1) on reply card.

Chemical Feed Proportioner

A new, non-electric, direct-from-drum proportioner named Pour-Portioner is announced by Sterling E. Norcross Companies. Fitting into the 2-in. head bung of all steel shipping drums through 55 gal, the pumpless proportioner either separately or simultaneously meters light to



viscous chemicals at drops-per-hour through a sight glass, or batch pours through a built-in faucet provision. Feeder operates by gravity feed with light liquids, or by available vacuum, pump suction, or compressed air for very viscous flow. *Sterling E. Norcross Companies.*

Circle number (2) on reply card.

Continuous Retrievable Formation Sampler

A new continuous retrievable sampler introduced by Halliburton is a combination drilling-testing tool which allows the packer to be run above the bit so that a formation may be tested at any time without the operator having to remove the pipe from the hole.

There are 2 main assemblies to the tool. The tool body contains the packer and packer inflation valve. The sampler assembly consists of a fishing neck for sand line removal, an optional number of retrievable sampler barrels, and a pressure recording device. The sampler is operated hydraulically by pump pressure. *Halliburton Oil Well Cementing Company.*

Circle number (3) on reply card.

For The "MR. CAP"
They Chose a
Thompson
VIBRATING SHALE SHAKER

Thompson . . . Perfect for Offshore Work!

On offshore rigs the reclamation of mud is vitally important and the separation of shale and abrasives from drilling muds means a more effective, time and money saving drilling job. Barnwell Offshore, Inc. chose Thompson for their new offshore rig, the MR. CAP, because it was field proven, will give them clean mud and make tools last longer, with a minimum of re-tooling and restoration of mud solution.

A Thompson Separator is your surest bet onshore . . . offshore . . . for shallow, medium and deep wells. The dependable Sample Machine works simultaneously with the separator, giving a foot-by-foot mud analysis with specimens. Write for Folder.

THOMPSON TOOL CO.
IOWA PARK, TEXAS

SOLD ONLY THROUGH SUPPLY STORES

ONLY GARRETT

TYPE DC

OFFERS

TYPE DA

TYPE TC

SO MANY

TYPE TA

MONEY-SAVING FEATURES

TYPE TPO

IN

TYPE DCB-I

SO MANY TYPES

TYPE CPC

OF

TYPE CPO-S-I

OIL FIELD MOTOR VALVES

TYPE DCB-I

Every feature of every Garrett Motor Valve is designed with the *oil field* in mind. Rugged, compact, light weight, totally enclosed yet easily accessible inner valves and stems, interchangeable hard and soft seats with balanced pressure and many other exclusive design features all add up to *real oil field valves*. You're missing the best if you are not using *Garrett* Motor Valves in all of your gas and liquid control operations.

For detailed information, write for Catalog No. 256 MVC.

TYPE DA-TS

USI Garrett Oil Tools

Division U. S. Industries, Inc.

P. O. Box 2427, Longview, Texas

New Equipment

Recorder Plots Rate, Weight, Torque

A drilling recorder that delivers 3 readings simultaneously — rate of penetration, drill string weight, and torque — has been announced by Totco. The instrument measures rate of penetration mechanically. A hydraulic system enables the

recorder to give readings on total drill string weight in suspension, weight on bottom, and changes in weight. A hydraulic system also determines torque. The instrument records all three operations on one permanent chart. *Technical Oil Tool Corporation.*

Circle number (4) on reply card.

Microfilm Viewer And Copier

A machine that makes large prints — up to 18 by 24 in. — of engineering drawings and other documents from microfilm, completely automatically, has been announced by Minnesota Mining and Manufacturing Company. Called the "Thermo-Fax" Twenty-Nine microfilm

reader-printer, the unit is both a reader and a printer in a single unit, producing prints in less than 15 seconds by push-button. A table-top unit, the reader-printer stands 32 in. high by 31 in. wide by 36 in. deep and operates on regular room current. *Minnesota Mining and Manufacturing Company.*

Circle number (5) on reply card.

COST TO OPEN?
COST TO CLOSE?

The new Cameron Gate Valve will give you more trouble-free operating cycles for your money than any other valve on the market. When you buy a valve for water, oil, gas or mud service, you are paying for opening and closing cycles. But how many for how much? This is the question more and more buyers of these valves are asking.

Any approved valve will hold pressure when new and first installed in the line, but what happens afterward determines the actual cost. The easy-operating Cameron Gate Valve will perform more opening and closing cycles without repair because of its exclusive rotating seat design. The wear pattern changes and extends the life of this unusual valve each time it is operated. No continuous lubrication program is necessary to maintain a tight, leakproof seal. Finally, when repairs become necessary, the Cameron Gate Valve need not be removed from the line for expensive shop repairs. A convenient sealing element package makes it a new valve in less than half the time required for other inline valve repairs. You can COUNT ON CAMERON Gate Valves for lowest cost per operating cycle.

Cameron
IRON WORKS, Inc.
P. O. Box 1212 — Houston, Texas
Export Office: 7912 Empire State Bldg., New York City; In England: Cameron Iron Works Ltd., 76 Grosvenor St., London W. 1 England.

Highly Portable Helicopter Rig

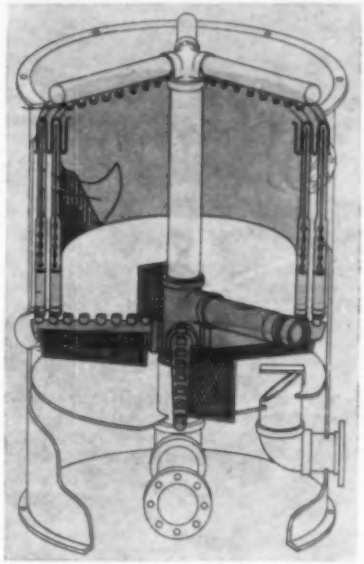
A drilling rig that overcomes transportation barriers is announced by National Supply. The new Type 4-10 helicopter rig is portable by helicopter, cargo plane, light vehicles, small boats, or barges. This portability has been achieved by designing assembly units weighing less than 4000 lb each. The rig can be converted in the field to a conventional rig, if desired.

Quick assembly is provided by special bolt fasteners for the main frame. A 2-speed transmission is a separate package, independently mounted. Engines are equipped with torque converters. *The National Supply Company.*

Circle number (6) on reply card.

Concentric Ring Water Filter

A new filter manufactured by Baker Filtration Company features a concentric-ring design for the filtration of water for flooding and disposal projects. A 54-in. unit contains 9 filter elements, presenting a total area of 290 sq ft. Filter elements are held apart by spacers and are individually replaceable. Cleaning is



accomplished by backwashing and high-speed rotary jet cleaning.

Corrosion safeguards include corrosion-resistant and synthetic materials used in the construction, epoxy-resin coating, and the use of a gas blanket to eliminate oxygen from the system. *Baker Filtration Company.*

Circle number (7) on reply card.

Rotary Rig for Water Wells

Bucyrus-Erie has introduced the heavy duty model 30-R for drilling medium-diameter water wells to a depth of 1000 ft. The new drill is available on 2 truck mountings — one with independent engine drive and the other with power takeoff from the truck engine. Down-the-hole tools are available for both units. Pipe racks hold 5 lengths of 20-ft 3-in. pipe. Speed of the high-torque hydraulic-top rotary drive can be varied from 0 to 100 rpm. *Bucyrus-Erie Company.*

Circle number (8) on reply card.

B and W
A Good Combination for a GOOD CEMENT JOB

OTHER PRIMARY CEMENTING TOOLS: Hinged Nu-Coil Scratchers • Rotating Scratchers, Multi-Flex and Nu-Coil Types • Automatic Stop Collars • Stabilizers • Rotator Collars • Liner Centralizers.

B and W Inc.
Well Completion Specialists

GULF COAST
Box 5266
Houston 12, Texas
Phone WA 3-6603

WEST COAST
19706 S. Normandie Ave.
Torrance, California
Phone FAculty 1-2463

123

RESISTS BENDING, GOUGING, ABRASION

another reason why drillers everywhere PREFER TM alloy spinning chains

Test certificate furnished.

Made from special analysis alloy steel, with a Brinell hardness of 265-285, to assure higher resistance to bending . . . gouging . . . abrasion. Short, stubby link design provides greater flexibility — snugger grips. Try TM Alloy Spinning Chain and see the big difference! Call your supply store or write for special Oil Field Bulletin.

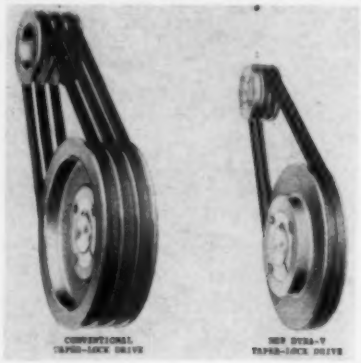
S. G. TAYLOR CHAIN CO., INC.
Hammond, Indiana
3505 Smallman St., Pittsburgh, Pa.

Taylor Made CHAIN SINCE 1873

New Equipment

Line of V-Drives Reduces Size, Weight

A new line of V-belt drives, featuring smaller and lighter sheaves and V-belts of higher capacity at lower cost, is announced by Dodge Manufacturing Corporation. Introduced under the name



Dyna-V, the drives cover the complete range of horsepower capacities available in conventional drives.

Besides the ⅜-in. (nominal top width) size, known as 3V, the company manufactures a 5V, or ⅝-in. size for higher horsepowers. Sheaves in the 3V series, from 1 to 10 grooves, are designed for drives ranging from 1 to 50 hp. The 5V series will include sheaves to take from 3 to 10 of the ⅝-in. belts, and will handle drives up to 200 hp. *Dodge Manufacturing Company.*

Circle number (9) on reply card.

Three-Wing Section Mill

A new section mill that mills at the rate of 2 to 4 ft per hr on N-80, S-95, and P-110 casing is now available from A-Z International Tool. The mill will open the standard 25 to 30-ft windows used for sidetracking operations in one trip into the hole. Cutting wings, each with a minimum of 3 cutting blades, are raised to milling position by pump pressure and casing collars can be easily located. *A-Z International Tool Company.*

Circle number (10) on reply card.

Hydraulic Wireline Valve

Bowen Itco announces a new hydraulic wireline valve. It has a 10,000 psi working pressure and has been tested at 20,000 psi. The valve has been designed for lubricator setups which employ single strand wire line and will effectively close on itself. The valve, though normally actuated through the use of hand pumps, may use available hydraulic pressure supplied by service trucks. *Bowen Itco, Inc.*

Circle number (11) on reply card.

Crankcase Oil Level Controller

A new line of oil controllers for engines has been announced by Kenco. The controllers protect unattended engines by adding oil, as required, maintaining the correct crankcase oil level automatically. The control head employs a float-controlled valve which feeds oil into the crankcase as required. It has a built-in low oil safety switch, visual crankcase oil level gage, and visual inlet oil screen condition indicator. *Kenco Engineering Company.*

Circle number (12) on reply card.

REDA PUMPS

FIRST CHOICE

FOR SECONDARY RECOVERY WATER FLOODING . . .

because pumping with REDA lowers costs and INCREASES PROFITS!

HERE'S HOW:

- Large water volume obtained from smaller size well casings reducing number of supply wells necessary
- Flexibility of Reda Pumps in meeting changing water requirements common to most waterflooding projects
- Easier, less expensive installation and lower maintenance costs
- Low operating costs and long operating life of Reda equipment
- Corrosion resistance of Reda pumps is superior to any other pumping unit used in supply wells

Reda Submergible Pumps are a major factor in the success of waterflooding and pressure maintenance operations. They are being used in major floods with very successful results of increased production and lowered costs.

Write for complete information today! Reda engineers will be pleased to call and assist in planning operations.

SIGN OF QUALITY . . SUBMERGIBLE REDA PUMPS

REDA PUMP COMPANY
BARTLESVILLE, OKLA.

Drilling-Producing Literature

Packer Retriever

A new 6-page brochure describing a packer retriever, a specialty tool which offers a safe measure for retrieving drillable production packers, has been made available by Bowen Itco. The folder covers use, advantages, operation (including operational cutaway drawings), complete instructions, and specifications of a number of sizes, as well as optional equipment. *Bowen Itco, Inc.*

Circle number (13) on reply card.

Diesel Engines For Oilfields

The complete line of Caterpillar engines for oilfield use is described in an 8-page booklet. The catalog summarizes the specifications of all current models and includes photos for ready reference. Engines for drilling, pipeline construction and pumping, diesel-electric power plants and marine applications are shown. *Caterpillar Tractor Company.*

Circle number (14) on reply card.

Automatic Control Panels

A 4-page bulletin is available from Control Panel Corporation which describes various automatic control systems built to user specifications or designed for specific duty. The bulletin lists uses by industry and provides informative data on specific applications. *Control Panel Corporation.*

Circle number (15) on reply card.

Fracture Method Simplifies Operation

A new planning method for fracturing jobs is available from Halliburton. The method correlates all known reservoir data, past fracturing experience in the area, and desired production figure. This information is then used with a new technical publication, "A Method for Fracturing Treatment Design," which employs curves, charts, and formulas that enable

the oil man to pick the fracturing treatment best for the particular well. Specific information required includes effective permeability, core analysis, porosity, bottom-hole temperature and pressure, bottom-hole viscosity of fluid, gas-oil ratio, and water production. In most cases this information is available or can be obtained from reliable sources such as drillstem tests, electric logs, laboratory tests, etc. *Halliburton Oil Well Cementing Company.*

Circle number (16) on reply card.

Casing Heads Described

National Type G casing heads in 8-in. and 10-in. sizes are described in a new bulletin by National Supply. The Type G head is designed for working pressures up to 2000 psi and for columnar loads up to 295,000 lb. The 4-page bulletin illustrates design features. These include full-opening through bores, demountable adapter flanges for preventer installation, and male thread adapters for tubing head installation. *The National Supply Company.*

Circle number (17) on reply card.

INCREASE PRODUCTION

CLEAN OUT CHOKING SAND

Excessive sand and sediment holds back your oil. For fast, easy cleanout with fewer round trips and less downtime, use world famous Miller Sand Pumps.

Write for descriptive price list.

SAND PUMP SIZES IN STOCK

O.D.—2½, 3, 3½, 4¼, 5, 5½, 7 in. Lengths, 20, 25, 30 ft.

Composite Catalog Page 3400

MILLER SAND PUMPS

Miller Sand Pump Co.
General Offices, Box 4516
Oklahoma City 9, Okla.

EXPORT OFFICES
30 Rockefeller Plaza
NEW YORK 20, N. Y.

SECONDARY RECOVERY
Since 1922

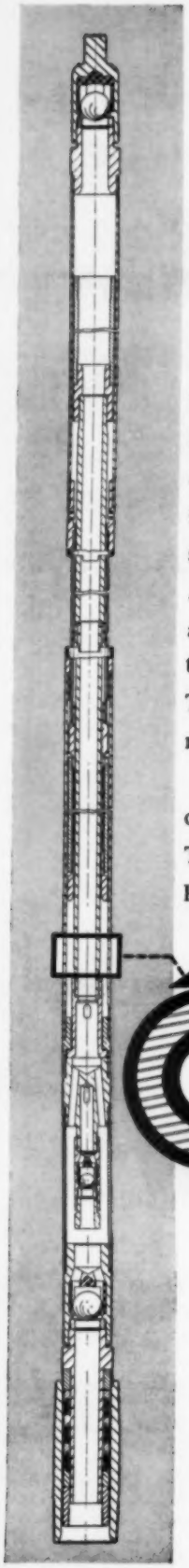
PETROLEUM ENGINEERS
CABLE & STEPHENS
WICHITA FALLS, TEXAS

RESERVOIR ENGINEERING
Water Flooding Gas Repressuring
EVALUATION CORE ANALYSIS
SURVEYS ECONOMICS
Cost Estimates, Design, Installation
FIELD SUPERVISION
Phone 723-2167

MUD SERVICE BY MILWHITE PAYS

MILWHITE

MUD SALES COMPANY
HOUSTON, TEXAS
DIVISION OF MISSISSIPPI RIVER FUEL CORPORATION



Get More Production with

PACIFIC'S DOUBLE BARREL

Insert Rod Plunger Pump

This particular design of Pacific's Type "D" Insert Rod Pump is one of the many tried, and is the direct result of engineering proved by actual field tests and operation. Over a period of years this pump was developed so that it could be removed on the rods for servicing . . . yet produce at capacities equal to or greater than a Tubing Liner Pump. Many problems were encountered, but for each a satisfactory solution was found. The result is a most efficient and trouble free insert rod pump for handling large capacities.

The Type "D" Insert Rod Pump consists basically of two R. W. pumps in tandem. The upper pump is a Traveling Barrel Pump. The lower pump is a Traveling Plunger Pump.

WRITE FOR BULLETIN 204

Vertical cross sectional view of lower pump displacement chamber showing area which is between Inner Plunger Tube and Precision Tube. This area represents approximately 60% of the upper pump. Both pumps load on the up stroke and discharge on the down stroke.

PACIFIC PUMPS
Inc. . . A Division of Dresser Industries, Inc.
HUNTINGTON PARK, CALIFORNIA

Mid-Continent :
1358 So. Sheridan Ave., Tulsa 12, Oklahoma
Pacific Pumps of Canada, Ltd.,
Edmonton, Alberta

DW-19

New Literature

Electric Drive For Drilling

Detailed information and technical data on General Electric's control system and components for electric drive for oil well drilling operations are contained in a new bulletin. Outlined are specifications of the control compartment and driller's console, as well as brief descriptions of the main electrical components and their function. Information about the exciter, electrical cable and connectors, and a connection box for tender-platform rigs is also provided. *General Electric Company.*

Circle number (18) on reply card.

Brochure Describes Recovery Services

A new brochure has been published by Petroleum Technologists describing the methods and services available from the company. The booklet describes the latest techniques and equipment of the company and includes such services as core analysis, flood evaluations, miscible phase drive, secondary recovery techniques, PVT evaluations, and recovery research. *Petroleum Technologists, Inc.*

Circle number (19) on reply card.

Tubing Joint Handbook

New Dual-Seal tubing joints are shown in a new handbook released by Hardy-Griffin. The joints feature a positive-sealing Teflon ring seal and a mechanical metal-to-metal thread seal. Originally designed for use on P-105 and higher grade tubing, the connection is also available for use in wells of all depths and conditions. In addition to complete data on the tubing joints, the 16-page catalog contains such information as how to calculate running clearance in casing. *Hardy-Griffin Engineering Corporation.*

Circle number (20) on reply card.

Separator Handbook

A new method of sizing oil and gas separators for a wide range of well stream conditions has recently been published in a 114-page book by BS&B. The method reduces affecting conditions and characteristics to factors, and incorporates these factors into a universally applicable equation. Factor values have been precalculated and tabulated to permit visual selection of separator sizes rather than mathematical computations of the correct value for a specific condition or characteristic. *Black, Sivalls & Bryson, Inc.*

Circle number (21) on reply card.

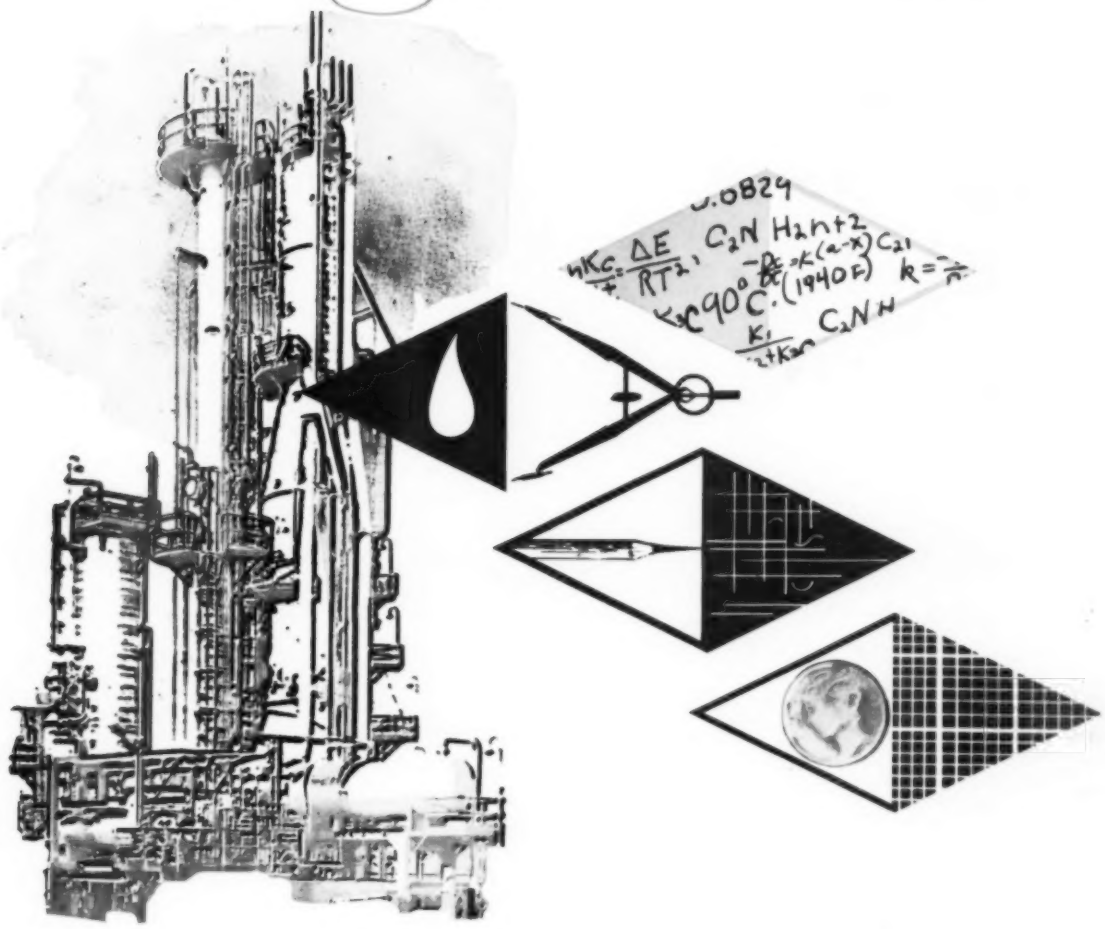
Complete Tool Line

An 8-page brochure illustrating the complete line of specialty tools and products manufactured by Pathfinder Oil Tool Company is available from the manufacturer. A centralizer specially designed for various operating conditions is illustrated. A well bore wiper, a stop collar, a special no-weld compound, and a lost circulation additive for which the company is distributor, are also covered in the brochure.

The company was formerly known as Oil Country Equipment Company, Inc. *Pathfinder Oil Tool Company.*

Circle number (22) on reply card.

intangibles were never so important



PRECISION CONSTRUCTION

Worker recruiting and training . . . special safety programs . . . on-the-spot solutions to pressing problems . . . these and other extras are included in Procon service. Applying such intangibles to construction of petroleum, chemical and petrochemical plants is the specialized function of Procon. Modern, efficient construction techniques form but a part of the precision construction system developed by Procon. That is why a Procon-built plant can be depended upon to more than meet specifications.

PROCON®

PROCON Incorporated

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U.S.A.

PROCON (CANADA) LIMITED, TORONTO 18, ONTARIO, CANADA

PROCON (GREAT BRITAIN) LIMITED, LONDON, W. C. 2, ENGLAND

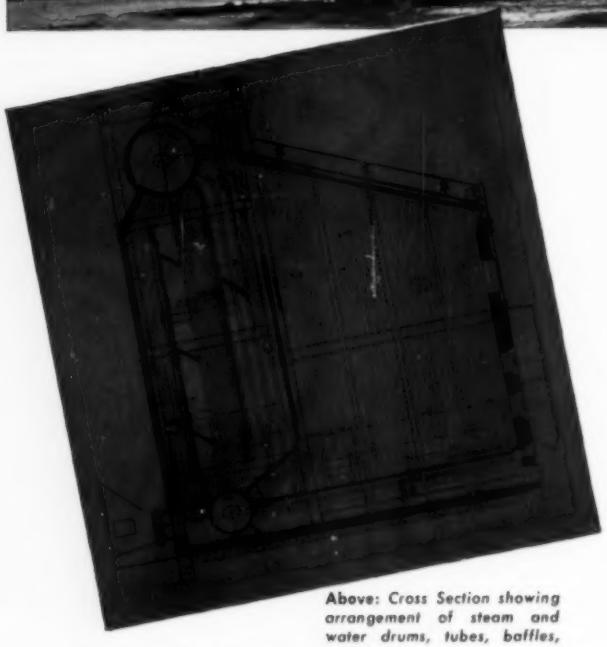
PROCON INTERNATIONAL S. A., SANTIAGO DE CUBA

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

Vogt STEAM GENERATORS

at SUNTIDE REFINING COMPANY

Viola, Texas



Above: *Cross Section showing arrangement of steam and water drums, tubes, baffles, and furnace.*

EFFICIENCY AND ECONOMY PROVED BY FIRST 3 UNITS . . . 2 MORE ADDED!

Principle Data Each Unit

- 85,000 pounds steam per hour capacity, designed for 500 lbs. S.W.P. and 625° F. total temperature.
- Water cooled furnace.
- Burners for Gas and Oil fuel.

Vogt offers a complete line of custom built and package type steam generators. Available in bent tube and straight tube designs for solid, liquid, or gaseous fuels burned singly or in combination.

Write for bulletins. Dept. 24A-BRE

OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings and Flanges—
Petroleum Refinery and Chemical Plant Equipment
Heat Exchangers
Ice Making and Refrigerating Equipment

HENRY VOGT MACHINE CO.

Box 1918, Louisville 1, Kentucky

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

1959 WORLD PETROLEUM CONGRESS NEW YORK

Abstracts of Technical Papers

Here are the highlights of the important refining and petrochemical papers for presentation at the Coliseum, New York, May 30-June 5

SECTION III
Oil Processing and Refining

Morning Session, June 1

PAPER 1

The Refiner Looks at Cars of the Future

J. A. Nevison, C. D. Wrigley, L. J. Test, Atlantic Refining Co., Philadelphia, Pa.

This refiner's view of cars of the future discusses the important factors which must be considered in preparing for tomorrow's motor fuels. Compression ratio, horsepower and octane trends, including forecasts of the future are presented.

PAPER 2

Processing Needs for Higher Quality Fuels

J. F. Walter, M. J. Sterba, Universal Oil Products Co., Des Plaines, Ill.

In addition to the maximum practical Research octane number, the gasoline of the future must, within the limits of economic feasibility, have maximum motor method octane number and minimum tendency toward engine fouling, vapor-lock and smog-favoring combustion products. It is probable that the fuel of the future will be based on supplementing existing facilities with plants for producing isopentane and iso-hexanes and the maximum amount of iso-paraffinic alkylate.

PAPER 3

A New Isomerization Process

K. P. Lanneau, W. F. Arey, Esso Standard Oil Co., Baton Rouge, La.; *S. F. Perry, A. Schriesheim,* Esso Research & Engineering Co., Linden, N.J.; *H. A. Holcomb,* Humble Oil & Refining Co., Baytown, Tex.

A new isomerization process for upgrading C_5/C_6 virgin naphthas. The process employs a highly active catalyst which permits liquid phase operation at low temperature, 80 to 120 F. Equilibrium isomer distribution at this temperature level favors formation of the branched, high octane isomers.

Afternoon Session, June 1

PAPER 5

Hydrogenation of Petroleum Fractions

W. E. Bradley, G. W. Hendricks, H. C. Huffman, A. E. Kelley, Union Oil Company of Calif., Brea, Calif.

The increasing demand for high octane motor gasolines has forced petroleum refiners to increase catalytic reforming capacity and to exercise less selectivity in choosing reformer charge stocks. This has resulted in rapid expansion of hydrotreating for feedstocks preparation.

PAPER 6

The I.F.P. Process for Hydrorefining of Crude Oil and Petroleum Fractions

C. Thonon, M. Alexandre, M. Verwaerde, G. Limido, Institut Francais du Petrole, Rueil-Malmaison, France.

A catalytic hydrogen treatment permits selective removal of the impurities of hydrogen sulfide, ammonia and water. The IFP has successfully developed a process defining optimum conditions, to upgrade a wide variety of petroleum products, from light distillates to crude oils and heavy residuals.

PAPER 7

Catalytic Refining and Hydro-Desulfurization of Mineral Oils

C. Padovani, V. Berti, Milan Polytechnic, Piazza Leonardo da Vinci, Italy; *D. Sartirana, B. Bosoni,* Societa Petrolifera Italiana, Fornovo Taro, Parma, Italy.

Part 1 deals with laboratory experiments in catalytic refining as performed on petroleum topping distillates; topping long cuts; catalytic cracking gasolines and light tar oils; catalytic cracking kerosine and gasoils; and deasphalted crudes.

Part 2 is a description and the operating data of a catalytic

How to handle TEL susceptibility in linear programming of gasoline blending studies

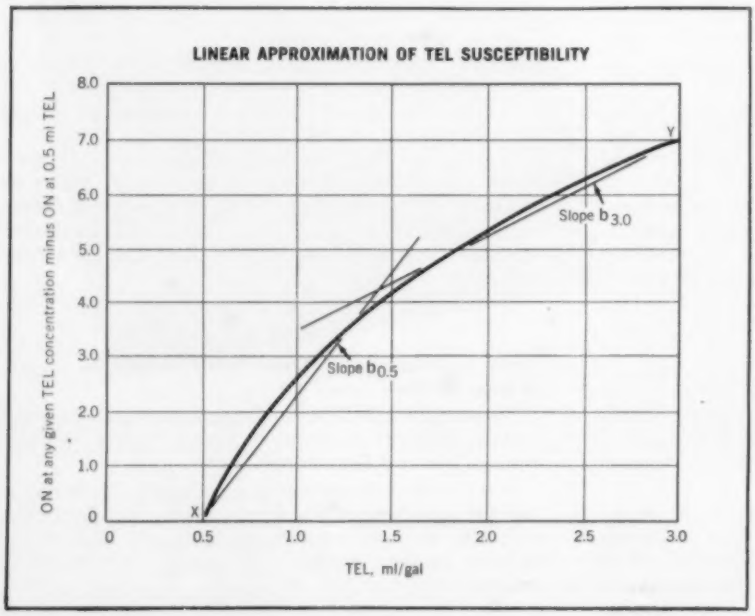
By Dr. W. C. Healy, Jr., Supervisor of the Mathematical Analysis Section,
Refinery Technology Division, Ethyl Research Laboratories

In past years, gasoline blending was comparatively simple. An engineer could establish optimum blends for two grades of gasoline by using a slide rule and a TEL response chart.

Today gasoline blending and establishing maximum antiknock effectiveness are much more complex. Many components are used to make numerous grades of gasoline. Often, market conditions divert some gasoline component to another product. All this presents the refiner with a giant-sized problem of blending for maximum profit.

The magnitude of the problem has forced the refiner to electronic computer solutions, using such techniques as linear programming.

Because TEL susceptibility is a non-linear function, it presents a special problem for computer studies when linear programming is used. Many suggestions have been made for handling the TEL function, and one of the simplest recorded to date is outlined here.



The Ethyl method of handling the TEL function is similar to others in that a target TEL susceptibility curve is approximated by straight-line segments having fixed slopes. However, it is easier to use because—

A. No extra variables are introduced.

B. No extra upper-bounding conditions are required.

C. Set-up time is reduced.

Calculating TEL linear approximations is not difficult when final blend TEL susceptibility* is known. It becomes difficult when susceptibility is to be determined by computer. Calculations must employ approximated susceptibility values while retaining accuracy for reasonable deviations.

*TEL susceptibility is here defined as the difference between octane numbers at 3.0 ml. TEL/gallon and at 0.5 ml. TEL/gallon.

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Here's How Ethyl's Method Works

For example, in the figure, two line segments are used to approximate the curve. The procedure is as follows:

A. Estimate a blend TEL susceptibility curve and then plot on rectangular coordinate paper.

B. Draw two approximating lines so that one line passes through point X (0.5, ON at 0.5) and the other line passes through Y (3.0, ON at 3.0).

C. Determine the slopes of these approximating lines, $b_{0.5}$ and $b_{3.0}$, as shown on the accompanying chart.

Then the following inequalities are required; they state that the ml. TEL per gallon shall be no less than that required on either line segment, and no greater than 3.0.

1. $\text{TEL} \geq \frac{\text{ON (specification)} - \text{(ON at 0.5)}}{b_{0.5}} + 0.5$

2. $\text{TEL} \geq \frac{\text{ON (specification)} - \text{(ON at 3.0)}}{b_{3.0}} + 3.0$

3. $\text{TEL} \leq 3.0$

Let

$X_1, X_2 \cdots X_n$ = Barrels of each component in the blend.

ON_i at 0.5 = Corresponding octane blending values at 0.5 ml. TEL/gal.

ON_i at 3.0 = Corresponding octane blending values at 3.0 ml. TEL/gal.

And $Y = (\text{TEL})(\Sigma X_i)$

Then substitute in 1 and 2 above

$$\text{ON at } 0.5 = \frac{\Sigma X_i (ON_i \text{ at } 0.5)}{\Sigma X_i}$$

$$\text{ON at } 3.0 = \frac{\Sigma X_i (ON_i \text{ at } 3.0)}{\Sigma X_i}$$

and multiply 3 by ΣX_i

These inequalities then reduce to the required linear expressions:

4. $\Sigma X_i (\text{ON spec} - ON_i \text{ at } 0.5 + 0.5\, b_{0.5}) - b_{0.5} Y \leq 0$

5. $\Sigma X_i (\text{ON spec} - ON_i \text{ at } 3.0 + 3.0\, b_{3.0}) - b_{3.0} Y \leq 0$

6. $Y - 3.0 \Sigma X_i \leq 0$

Under certain conditions the number of inequalities may be reduced to two.

Susceptibility Changes Are Compensated

Error-compensation is a built-in feature with this method since, when blend susceptibility varies (higher or lower) from the estimated value, the line segments adjust themselves to the proper portion of the new curve.

For greater accuracy, more than two line segments may be used to approximate the susceptibility curve. This requires additional analogous inequalities, but no additional variables.

Each additional octane specification calls for an estimated susceptibility curve and the statement of inequalities as shown above.

Checking the Program Before the Computer Run.

How Ethyl Research is helping you

Ethyl Research has several years' experience with linear programming as it applies to gasoline blending. This background has been especially valuable for customer service work.

The new method of handling tetraethyllead susceptibility is one example of the professional assistance available to the refiner from Ethyl.

In addition, the Mathematical Analysis Section in our Refinery Technology Division will be glad to share its experience in computation techniques with your people.

For further information, just call your Ethyl Representative. He'll be glad to arrange an appointment for you with one of our Mathematical Analysts.

ETHYL CORPORATION
New York 17, N. Y.

ETHYL ANTIKNOCK COMPOUND — ETHYL CORPORATION

RESEARCH LABORATORIES:
1600 W. Eight Mile Road, Ferndale 20, Mich.
2600 Cajon Road, San Bernardino, Calif.

refining plant built by the Societa Petrolifera Italiana at Fornovo Taro (Parma, Italy). The catalytic unit has a fixed-bed catalyst composed of cobalt-molybdate on a natural alumina support.

PAPER 31

The Importance of Hydrodesulfurization in the Processing Economy of a European Refinery

G. de Sanctis, P. Messenio, G. Distante, G. Pacini, and *A. Cajo,* Condor Societa per l'Industria Petrolifera e Chimica, Milan, Italy.

Discusses the catalytic desulfurization of S. R. middle distillates and light, middle and heavy catalytic cracking distillates under operating conditions of different severity in the pilot plant and Trickle unit of an Italian refinery. The effect on total refinery economics by the addition of the Trickle unit to the processing cycle on typical Middle East crude has been considered. Results have been compared with those obtainable by replacing hydrodesulfurization with either pentane isomerization or rexforming or alkylation.

Morning Session, June 2

PAPER 8

Studies on a Commercial Two-Stage Catalytic Cracking Plant

C. A. Rehbein, Shell Oil Co., New York, N. Y.; *W. A. Mitchell, R. A. Wilson,* Shell Oil Co., Anacortes, Wash.; *W. V. Medlin,* Shell Development Co., Emeryville, Calif.

Presented is a brief description of the two-stage catalytic cracking plant operated by Shell Oil Co. relating commercial experience with several types of feed stocks, the results of engineering studies of certain features of the unit and a summary of a detailed economic analysis of the process.

PAPER 9

Catalysts on the Basis of Acid-Activated Montmorillonites

Werner Franz, Phillipp Gunther, Carl E. Hofstadt, Sud-Chemie A.G., Munich/Germany

Several theories are discussed dealing with the explanation of the unique physical-chemical behavior of these bentonites and the reason for the catalytic properties of various catalysts produced by hot and cold acid treatment.

PAPER 10

Withdrawn by U.S.S.R.

Afternoon Session, June 2

PAPER 11

Chemical Changes in Lubricating Oil on Hydrofining

R. M. Butler, R. Kartzmark, Imperial Oil Ltd., Sarnia, Ont., Can.

Three non-extracted lubricating oil distillates were Hydrofined. In each case it was found that the concentration of aromatics in the low boiling end of the oil was increased by Hydrofining while the reverse was true of the high boiling end.

PAPER 12

Hydrorefining in the Manufacture of Bright Stock

A. Acker, B. Choisnet; Esso Standard S.A.F., Notre-Dame de Gravenchon, France.

Application of hydrorefining to Bright Stock manufacture was studied in a pilot plant as a finishing treatment to replace clay treatment and as a refining process to reduce deasphalting severity and avoid clay treatment.

PAPER 13

Catalytic Dearomatization of Light Distillates and Hydro-Finishing of Lubricating Oils

A. Campagnat, J. Demeester, C. Rouit, Societe Francaise des Petroles, Paris, France.

(1) Catalytic dearomatization of light distillates, kerosines and petroleum solvents yields distillates devoid of aromatics, which have an increasing market demand. (2) The hydrogenation refining of lubricating oils at moderate temperatures and pressures improves its stability and color. It is efficient when oils already refined by selective solvents are treated.

Morning Session, June 3

PAPER 14

Withdrawn by U.S.S.R.

PAPER 15

Dehydrogenation of Naphthenic Lubricating Oil Fractions

T. F. Brown, P. Mathews, Lobitos Oilfields, Ltd. Cheshire, England.

High concentrations of mono-nuclear aromatic hydrocarbons can be produced from naphthenic lubricating oil distillates by liquid phase dehydrogenation of the aromatic-free distillate over a platinum catalyst. The equipment required is simple and the estimated near operating cost of the process is $1.25 per bbl of feed.

PAPER 24

Elementary Processes of Mass Transfer in Extraction, Absorption and Distillation

H. Kroepelin, H. J. Neumann, and *E. Prott,* Institut für Chemische Technologie der Technischen Hochschule Braunschweig, Braunschweig, Fasanenstr, Germany.

Mass transfer was studied on individual droplets in liquid/liquid extraction.

PAPER 32

Solvent Extraction of Mineral Oils, Influence on the Selectivity of Solvents

F. J. Pass, H. Poll, and *J. F. Schuster,* Dept. of Applied Organic Chemistry, Institute of Technology, Vienna, Austria.

Comparative solvent refining is reported with cresol, phenol and furfurol as influenced by water content.

Afternoon Session, June 3

PAPER 16

Sweetening of Petroleum Products by Catalytic Oxidation with Sulfur Dyes

E. Weisang, A. Valet, Centre de Recherches de la Compagnie Francaise de Raffinage, Paris, France.

A new refining process affecting the sweetening of hydrocarbon mixtures containing mercaptans is accomplished with the aid of a catalyst in the presence of air. The oxidation catalyst is one of the sulfur dyes. The low cost of the catalyst makes the process economically attractive.

PAPER 17

Treating Aromatic By-Product Light Oils from Pyrolitic Conversions by the Basf-Scholven Process for Light Oil Refining

Ortwin Reitz, Badische Anilin & Soda-Fabrik AG, Ludwigshafen/Rhein, Germany.

In Germany, the process of refining light oils or crude benzol by sulfuric acid has been largely replaced by catalytic pressure refining, using hydrogen-containing gases, and employing the BASF-Scholven process. The yield and quality of catalytically refined products are much higher by this process.

PAPER 18

Development in Treating Processes for the Petroleum Industry

J. W. le Nobel, J. H. Choufoer, Koninklijke/Shell-Laboratorium, Amsterdam-N, Netherlands.

Recent developments in three processes for the removal and conversion of sulfur compounds present in oil products are discussed. Details of the Air-Solutizer Sweetening process, Mercaptor process and the Shell Trickle Hydrodesulfurization process are reviewed.

Morning Session, June 4

PAPER 19

Refinery Studies by Digital Computer

H. F. Lindsay, Tidewater Oil Co., Los Angeles, Calif.; *R. H. Wulzen,* Tidewater Oil Co., Asso., Calif.

Methods have been created for duplicating electronically in a digital computer the step-by-step processes of refining any predetermined mixture of crude oils and blending stocks in either of Tidewater's two refineries. One such system, the Avon refinery simulation program, is described in detail.

PAPER 20

Economic Problems of Refining Studied with the Aid of Linear Program Theory and Modern Electronic Computers

C. Berline, Societe des Petroles Shell Berre, Mareil Marly, France; *J. Wels,* Compagnie de Raffinage Shell Berre, Paris, France.

Linear program studies of two essential refining problems: The choice of the best production scheme in existing plants, and the calculation of the most effective investment in the development and creation of future refineries are discussed.

PAPER 21

Conjunct Polymerization of Ethylene With Hererpoly Acid Catalysts

J. W. Klinkenberg and *H. I. Waterman,* Delft Technical University, Department of Chemical Technology, Julianalaan 136, Delft, The Netherlands.

Acid catalysts consisting of a heteropoly acid proved to be very active in the "conjunct" polymerization of ethylene from diluted feed streams. Aromatization to such an extent and at such low temperatures by acid type catalysts has never before been reported in literature.

Afternoon Session, June 4

PAPER 22

Extraction of Aromatics with Sulfolane

C. H. Deal, Jr., H. D. Evans, E. D. Oliver, and *M. N. Papadopoulos,* Shell Development Co., Emeryville, Calif.

This paper gives basic properties of Shell Development Co.'s commercial sulfolane and diethylene glycol (DEG) and presents bench scale data for sulfolane extraction to produce high purity aromatics. In addition, commercial process designs are presented, discussed and compared with those for DEG.

PAPER 23

Gasoline Upgrading with the Use of Selective Adsorbents

Dr. G. R. Brown, Jr., Dr. R. A. Rightmire, and *Dr. H. A. Strecker,* Standard Oil Co. of Ohio, Cleveland, Ohio.

Techniques are described that utilize molecular sieve materials for the upgrading of light crude naphtha and for the improvement of the reforming and alkylation processes. A mathematical method for design of optimum cycles for fixed bed adsorption on molecular sieves is presented.

PAPER 4

Reactions in Catalytic Reforming of Naphthas

H. G. Krane, A. B. Groh, Standard Oil Co., Whiting, Ind.; *B. L. Shulman, J. H. Sinfelt,* Esso Research & Engineering Co., Linden, N. J.

Catalytic reforming is today's most important refinery process for octane improvement. The most efficient use of reforming requires a thorough knowledge of changes in molecular composition over a range of operating conditions. Kinetic models have been developed for n-heptane and for the principal reactions of whole naphtha. Fifty-three reaction steps are covered.

Morning Session, June 5

PAPER 25

The Use of Gaseous Sulfur Trioxide in the Sulfonation of Petroleum Oils

H. Kaye, E. Forsyth and *A. L. Mills,* Manchester Oil Refinery Ltd., Manchester, England.

White oil manufacture using gaseous sulfur trioxide has been investigated and is compared with the conventional oleum usage. A plant is described which has operated satisfactorily for a year.

PAPER 26

Selective Hydrogenation Process for the Refining of Steam Cracker Gasoline

P. T. White, F. W. B. Porter and *A. A. Yeo,* British Petroleum Co., Ltd., Middlesex, England.

This paper describes the development of a selective hydrogenation process designed to improve the stability of a high octane number gasoline fraction produced during the manufacture of ethylene by the high-temperature steam pyrolysis of hydrocarbons.

PAPER 27

25 Years Fischer-Tropsch Synthesis with Fixed-Bed Catalysts. Present Status and Future Possibilities

Heinrich Tramm, Managing Board of Ruhrchemie Aktiengesellschaft, Obershausen-Holten, Germany.

In the past 25 years, 19 Fischer-Tropsch fixed-bed synthesis plants have been installed. The most modern plant now onstream with full success is in South Africa and is equipped with reactors having 25 times the output of the original reactors. The possibilities of producing motor fuels and lubricating oil and the importance of the Fischer-Tropsch products in the chemical industry are described.

Afternoon Session, June 5

PAPER 28

The Fluid Coking Process - Commercial Experience to Date

James McDonald, Tidewater Oil Co., Los Angeles, Calif.; *C. O. Rhys, Jr.,* Esso Research & Engineering, Linden, N. J.

The successful operation of commercial plants has established fluid coking as a versatile, rugged and reliable petroleum processing tool. A brief economic review, based on the performance of actual fluid cokers indicates that the plants are capturing attractive returns on the investment. Commercially proved capabilities of this new process to handle feed stocks ranging from atmospheric to vacuum residua make fluid coking an attractive method for reducing residual fuel production.

PAPER 29

Withdrawn by U.S.S.R.

PAPER 30

Catalytic Processing of Residual Fuel Stocks

R. E. Bland, R. E. Ashwill, J. B. Maerker, and *W. J. Cross,* Houdry Process Corp., Philadelphia, Pa.

This paper discusses the Houdresid process, a commercially-proved moving bed catalytic cracking process capable of converting residua into high quality products. This paper gives a summary of the economic justifications for the process and discussion of the process schemes which are most attractive.

For More Information . . .

. . . on any phase of the Congress and related activities, contact:

Fifth World Petroleum Congress, Inc.
527 Madison Avenue
New York 22, N. Y.

Or telephone the New York City Number:
MUrray Hill 8-7145

SECTION IV
Chemicals from Petroleum and Natural Gas

Morning Session, June 1

PAPER 1

Manufacture and Utilization of Aromatics from Petroleum

H. W. Earhart, R. L. Heinrich, E. W. Lewis, T. M. Newsom, and *E. F. Wadley,* Humble Oil and Refining Co., Baytown, Tex.

Primarily devoted to reviewing the potential availability of aromatic hydrocarbons and their end use application. It discusses the manufacturing steps employed by the petroleum industry for producing aromatic hydrocarbons, and discusses synthesis methods which have been developed recently for producing aromatic hydrocarbons.

PAPER 2

Two-Stage Process for Production of Naphthalene and High Octane Gasoline from Cycle Stock

B. S. Friedman and *S. M. Kovach,* The Sinclair Research Lab., Inc., Harvey, Ill.

A two-stage operation has been devised which avoids solvent extraction. First, a catalytic light oil cycle stock is processed under mild hydrocracking conditions. Then the aromatic recycle oil is retreated under more severe conditions to dealkylate the alkylnaphthalene components.

PAPER 3. Withdrawn by U.S.S.R.

Afternoon Session, June 1

PAPER 4

The Kinetics of Pyrolysis of Ethane and Related Hydrocarbons

H. G. Davis and *K. D. Williamson,* Union Carbide Olefins Co., Div. of Union Carbide Corp., South Charleston, W. Va.

Experiments on the rate of formation of minor products in the pyrolysis of ethane have led to a new knowledge of the kinetics and mechanism of pyrolysis. Chromatography and radioactive tracers were used to confirm the findings.

PAPER 5

Fundamental Relationships in the Pyrolysis of Hydrocarbons to Acetylene and Ethylene

Hans Krekeler, Rudolf Wirtz, and *Nikolaus Pechtold,* Farbwerke Hoechst AG, Frankfurt a. Main, Germany.

Influence of cracking temperature and feed stock composition on yield and composition of the end products has been studied in a high-temperature pilot cracking unit.

PAPER 6

Acetylene Production from the Pyrolysis of Liquid Hydrocarbon Feedstocks

F. F. Braconier, P. J. Leroux, Societe Belge de L'Azote, Liege, Belgium; *G. C. Grubb,* and *W. W. Walk,* The M. W. Kellogg Co., N.Y.

Discusses the production of acetylene from liquid hydrocarbon feedstocks. Investment and operating costs are given for the production of acetylene from light naphtha, comparing these costs with the production of acetylene from methane and natural gas, and showing the influence of the coproduction of ethylene.

Morning Session, June 2

PAPER 7

Comparison of Performance and Octane Number Requirements of American and European Cars

G. B. Cipollina, Mobil Oil Italiana, S.p.A. Genoa, Italy; *G. A. Dickins,* Mobil Oil Company, Ltd., London, England; *O. P. Meese,* Mobil Oil A.G. in Deutschland, Hamburg, Germany; *P. A. Meronneau,* Mobil Oil Francaise, Paris, France.

After reviewing the essential differences between the respective car populations and operating conditions, an analysis is made of the effects of these differences on various aspects of the quality requirements of fuels and also of lubricants in so far as they affect fuel utilization.

PAPER 8

Cracking of Gaseous Hydrocarbons by Partial Oxidation

E. Bartholome and *H. Nonnenmacher,* Ammoniaklaboratorium der Badischen Anilin-und Soda-Fabrik AG, Ludwigshafen am Rhein, Germany.

Partial oxidation is an effective means for the supply of heat to endothermic cracking reactions. The method is illustrated by three different processes: (1) Homogeneous cracking with controlled quenching for the production of acetylene; (2) heterogeneous cracking on inert solid materials for the production of olefins; (3) heterogeneous cracking on catalysts for the production of synthesis gas.

PAPER 9. Withdrawn by U.S.S.R.

Afternoon Session, June 2

PAPER 10

Butadiene Production - Commercial Practice With Dow Catalysts

R. J. Harbour, The Dow Chemical Co., Midland, Mich.

Data from certain operating facilities utilizing the Dow catalyst process for butadiene production are presented, showing product distribution and yield. Also outlined are process conditions, mechanical design features and operating techniques whereby these results are obtained.

PAPER 11

Process for the Manufacture of Isoprene

M. Hellin, H. Guerpillon, and *F. Coussemant,* Institut Francais du Petrole, Rueil-Malmaison, France.

A two-step reaction process for the manufacture of isoprene studied at the IFP is discussed in this paper. Taking into account the yields obtained, as well as the low investment costs resulting from the simplicity of the equipment, a cost price can be foreseen for isoprene which would give polyisoprene a choice place on the market of synthetic rubber.

PAPER 12

The Preparation of Conjugated Diolefins by Hydroperoxydation of Olefins

G. M. Clement, J. C. Balaceanu, Institut Francais du Petrole, Rueil-Malmaison, France.

This new synthesis method for alpha-ethylenic alcohol and their corresponding diolefins is particularly economical and seems, at present, to be the only one that could be used industrially.

Morning Session, June 3

PAPER 13

The Production of Synthesis Gas by Partial Oxidation

duBois Eastman, Texaco, Inc., Montebello, Calif.

Discusses the current status of the partial oxidation processes which are licensed by Texaco Development Corporation and used to produce synthesis gas — a mixture rich in hydrogen and carbon monoxide. Performance data are given for a series of fuels.

PAPER 14

Recent Developments in the Oxo Process

V. N. Hurd, Gulf Oil Corp., Pittsburgh, Pa.; *B. H. Gwynn,* Gulf Research & Development Co., Pittsburgh, Pa.

The oxo process is a method of converting olefins to aldehydes. The process depths are described briefly from the production of synthesis gas and hydrogen to the hydrogenation of aldehydes to alcohols.

PAPER 15. Withdrawn by U.S.S.R.

Afternoon Session, June 3

PAPER 16

Hydrogen Peroxide: New Techniques for its Utilization

George B. Payne, Shell Development Co., Emeryville, Calif.

With the increasing availability in recent years of a purer and more stable hydrogen peroxide, new means have been sought for its utilization. This gives a review of some of the reactions utilizing hydrogen peroxide, in conjunction with various catalysts.

PAPER 17

A New Process for Oxidation of Aromatics

D. E. Burney, G. H. Weisemann, and *Nathan Fragen,* Standard Oil Co. (Indiana), Whiting, Ind.

A general method for the oxidation of alkyl aromatics to aromatic carboxylic acids has been developed. The catalyst system is composed of bromine — either as the element or as a compound — and a heavy-metal oxidation catalyst.

PAPER 18

Production of Aromatic Dicarboxylic Acids

J. P. Fortuin, M. J. Waale and *R. P. van Oosten,* Koninklijke/Shell-Laboratorium, Amsterdam and N. V. de Bataafsche Petroleum Maatschappij, The Netherlands.

A new route for the manufacture of two important aromatic dicarboxylic acids is described. It comprises a new alkylation technique and a selective catalytic liquid-phase air oxidation process.

Morning Session, June 4

PAPER 19

Acetaldehyde As Raw Material for Acrylonitrile

Kurt Sennewald, Knapsack-Griesheim Aktiengesellschaft, Knapsack near Cologne, Germany.

Ethylene and acetylene are compared with regard to their importance as raw materials for the manufacture of acrylonitrile, and the reasons for the dominating position of acetylene in the acrylonitrile field are given.

PAPER 20

Detergent Alkylsulfonates Derived from Petroleum Hydrocarbons Through Hydroperoxides

A. Baniel, Israel Mining Corp., Haifa Israel; *B. H. Vromen,* Graver Water Conditioning Co., New York, N.Y.

The hydroperoxides are reacted with sodium bisulfite to give a sulfonate that has a high solubility in water and salt solutions, good wetting properties, low foam, and excellent detergency.

PAPER 21

Relationship Between the Structure of Phenyldodecane Isomers and Their Performance as Detergent Base Materials

J. J. Tjepkema, B. Paulis, N. V. DeBataafsche Petroleum Maatschappij, The Hague; *H. W. Huijser,* Koninklijke/Shell-Laboratorium, Amsterdam.

Described are some of the properties of the five isomeric phenyldodecanes which are obtained as a mixture in the reaction of benzene with n-dodecane-1.

PAPER 22. No paper listed.

Afternoon Session, June 4

PAPER 23

New Plastics from Petroleum

Giulio Balabio, Montecatini Soc. Gen., Milan, Italy.

Growth of the petroleum derivatives industry in Western Europe is reviewed. Some new polymers of olefins and diolefins produced recently in Italy are described, and prospects for future developments are summarized.

PAPER 24

New Classes of Plastic, Rubbers, and Textile Fibers from Petroleum

Instituto Di Chimica Industriale Politecnico Di Milano, Italy.

Paper not received.

PAPER 25. Withdrawn by U.S.S.R.

Morning Session, June 5

PAPER 26

The Polymerization of Acetylene and Homologues

Alfred Clark, J. P. Hogan, D. R. Witt and *W. C. Lanning,* Phillips Petroleum Co., Bartlesville, Okla.

Acetylene has been polymerized over a chromium trioxide-silica-alumina catalyst to give high yields of benzene. A survey of reaction conditions is discussed.

PAPER 27

Oil Extension of Synthetic Rubbers

E. J. Buckler and *J. M. Mitchell,* Polymer Corp., Ltd., Sarnia, Can.

Oil extension of synthetic rubbers comprises substitution of the low molecular weight fractions of ordinary synthetic rubber by relatively inexpensive hydrocarbon oils. Studies extending over the past 10 years have been summarized with a view to clarifying the basic principles and scope of oil extension.

PAPER 28

Summary of the Synthetic Fiber Industry

Roy W. Sudhoff, The Chemstrand Corp., Decatur, Ala.

The preparation of fully synthetic fibers is discussed. Steps in the synthesis of monomers, their conversion to polymer and the spinning into fibers are outlined.

Afternoon Session, June 5

PAPER 29

Improved Process for Sulfur Recovery from Refinery Gases

R. W. Rieve, P. M. Pitts, Jr., and *L. N. Leum,* The Atlantic Refining Co., Philadelphia, Pa.

A new process for converting hydrogen sulfide to sulfur has been developed in the laboratories of The Atlantic Refining Co. The process uses a basic aqueous solution of a multivalent ion such as iron in conjunction with a chelating agent to absorb hydrogen sulfide and oxidize it to sulfur.

PAPER 30

Thianaphthene and Homologs from Hydrocarbons and Hydrogen Sulfide

J. A. Patterson, R. E. Conary, R. F. McCleary, C. H. Culnane, L. E. Ruidisch, C. B. Holder, Texaco Research Center, Beacon, N. Y.

The technique used for preparing thiophene compounds from aliphatic hydrocarbons and hydrogen sulfide over such catalysts as chromia or molybdena on alumina has been extended to aromatic hydrocarbons capable of forming the condensed thiophene nucleus. Reactions and yields as well as various catalysts are discussed.

PAPER 31

Integration of Petroleum Chemicals Operations

Denis W. Huebner, William A. Mason, and *James W. Woolcock,* Imperial Chemicals, Ltd., Billingham, England.

Discussed here is the integration of a petrochemical operation. The overall success of an integrated scheme such as this depends upon a large number of factors which are broadly discussed. ★ ★ ★

For Turbulent Flow . . .

GRAPHIC METHOD SPEEDS LINE SIZING

Here is a chart to reduce time . . . yet retain accuracy

Dr. K. S. McMahon,
Wyatt C. Hedrick Engineering Corporation
Houston, Texas

J. C. Webb,
Editor
Refining Engineer

SIZING PROCESS LINES DURING PLANT DESIGN is generally considered a "chore." Because the cost of a process and utility piping system usually accounts for 5 to 15 percent of the total capital cost, this "chore" is a very important phase of plant design.

Here is an alignment method for sizing lines in turbulent flow that will greatly reduce the calculation time required while retaining accuracy.

Line Loss Chart

The chart presented in Fig. 1 is patterned after a similar "line loss" chart developed by an unidentified author at the former Standard Oil Development Company. The formulas and physical property correlations have been changed to improve both range and flexibility. The chart formulas and fluid property correlations are believed to be improvements over similar ones used in other alignment charts.

Friction Factor

The basic assumptions for the chart in Fig. 1 is that Fanning friction factors for new steel pipe may be represented by the equation

$$f = (0.0310)\ (Re)^{-0.15} \quad . \quad . \quad . \quad . \quad (1)$$

From this assumption and using Fanning's equation, one can derive the following equation for pressure loss in turbulent flow lines

$$\triangle P = \frac{(3.16 \times 10^{-5})\ (lb/hr)^{1.85}\ (\mu)^{0.15}}{(ID)^{4.85}\ (lb/cu\ ft)} \left(\frac{130}{C_{hw}}\right)^{1.85} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Where: $\triangle P$ = psi per 100 ft
C_{hw} = Hazen-Williams coefficient
μ = viscosity, centipoise
ID = inside diameter, in.

In the Reynolds Number range from 10,000 to 1,000,000, Equation 1 gives friction factors within ± 10 percent or the friction factors for pipe given by Perry's *Chemical Engineer's Handbook:* Walker, Lewis, McAdams, and Gilliland's *Principles of Chemical Engineering,* or Maxwell's *Data Book on Hydrocarbons.* It also agrees reasonably well with friction factors in the transition zone of Moody-type charts for 1-in. to 12-in. lines at Reynolds Numbers commonly employed.

Equation 1 does not allow for surface roughness in pipe, but the chart formula (Equation 2) does include the commonly used Hazen-Williams coefficients. The H-W coefficients are applied on the approximation that the inner surface of the pipe is smooth and that the action of corrosion or scaling is simply to reduce the effective line capacity.

Pressure drops calculated by Fig. 1 will be found to differ only slightly from those calculated by more tedious methods except for line diameters less than 1-in. and greater than 12-in., or at Reynolds Numbers less than 4000 or greater than 3,000,000.

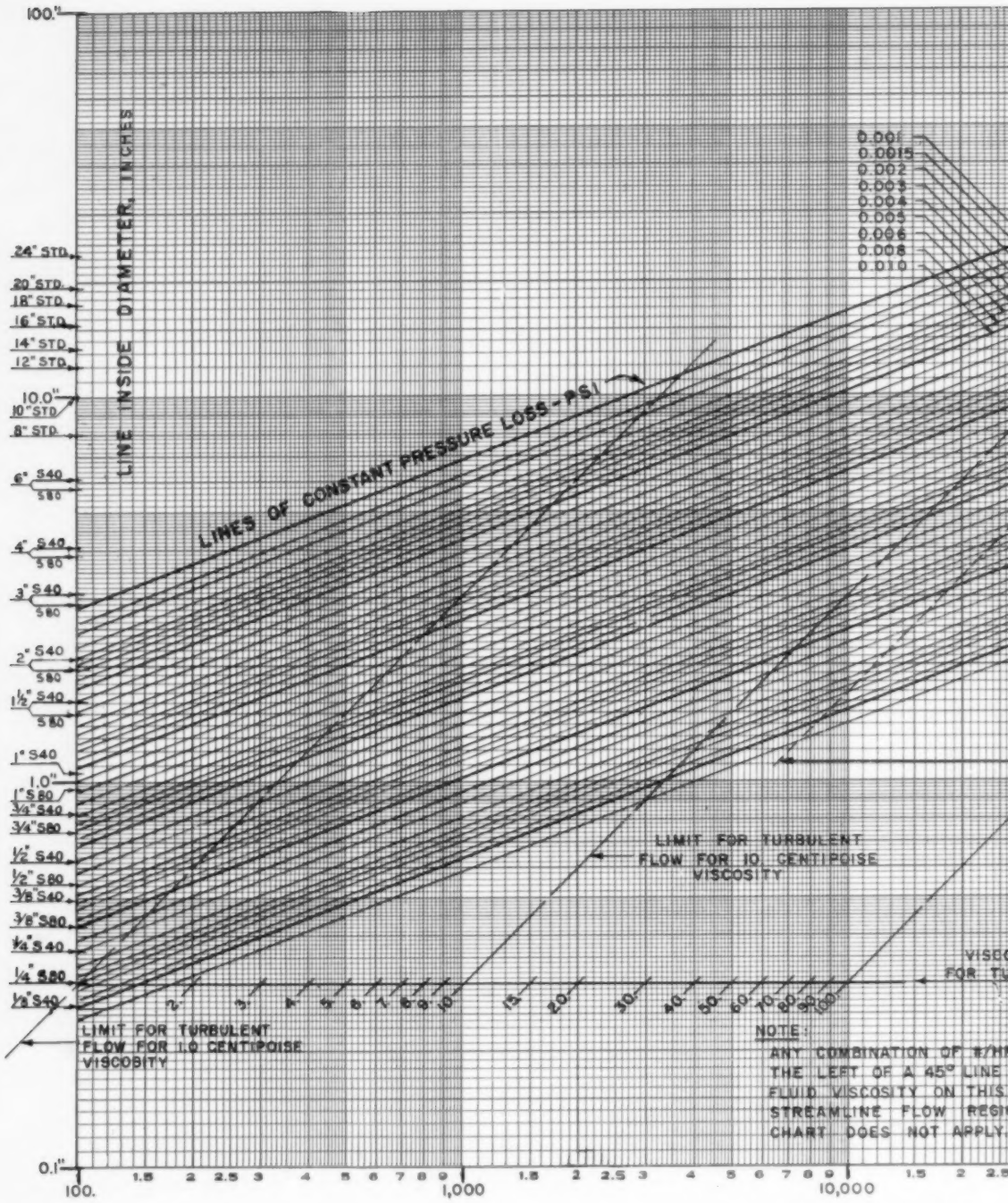
Two factors tend to offset the chart inaccuracies in the regions mentioned.

The first is the use of equivalent lengths of fittings (L_e) provided in Tables 1 and 2. Since, in the more tedious methods of line pressure loss calculations, equivalent lengths would ordinarily be corrected for Reynolds Number, the fitting corrections at lower Reynolds Numbers tend to compensate for the chart inaccuracies when the pressure loss for an entire line is calculated.

The second factor is that most "normal" piping falls in the more accurate range of the chart; this range is extended for gases at high Reynolds Numbers by an arbitrary change of the Hazen-Williams coefficient.

The chart is not intended for use on such problems as sizing gas transmission lines and determining pressure losses or capacities in short vapor lines at high-pressure drops.

FOLD OUT FOR CHART — →


LINE INSIDE DIAMETER, INCHES
100."
24" STD.
20" STD.
18" STD.
16" STD.
14" STD.
12" STD.
10.0"
10" STD.
8" STD.
6" S40
S80
4" S40
S80
3" S40
S80
2" S40
S80
1½" S40
S80
1" S40
1.0"
1" S80
¾" S40
¾" S80
½" S40
½" S80
⅜" S40
⅜" S80
¼" S40
¼" S80
⅛" S40
0.1"
LINES OF CONSTANT PRESSURE LOSS - PSI
0.001
0.0015
0.002
0.003
0.004
0.005
0.006
0.008
0.010
LIMIT FOR TURBULENT FLOW FOR 10 CENTIPOISE VISCOSITY
LIMIT FOR TURBULENT FLOW FOR 1.0 CENTIPOISE VISCOBITY
NOTE:
ANY COMBINATION OF
THE LEFT OF A 45° LINE
FLUID VISCOSITY ON THIS
STREAMLINE FLOW REGI
CHART DOES NOT APPLY.
100.
1,000
10,000
FLOW RATE ,

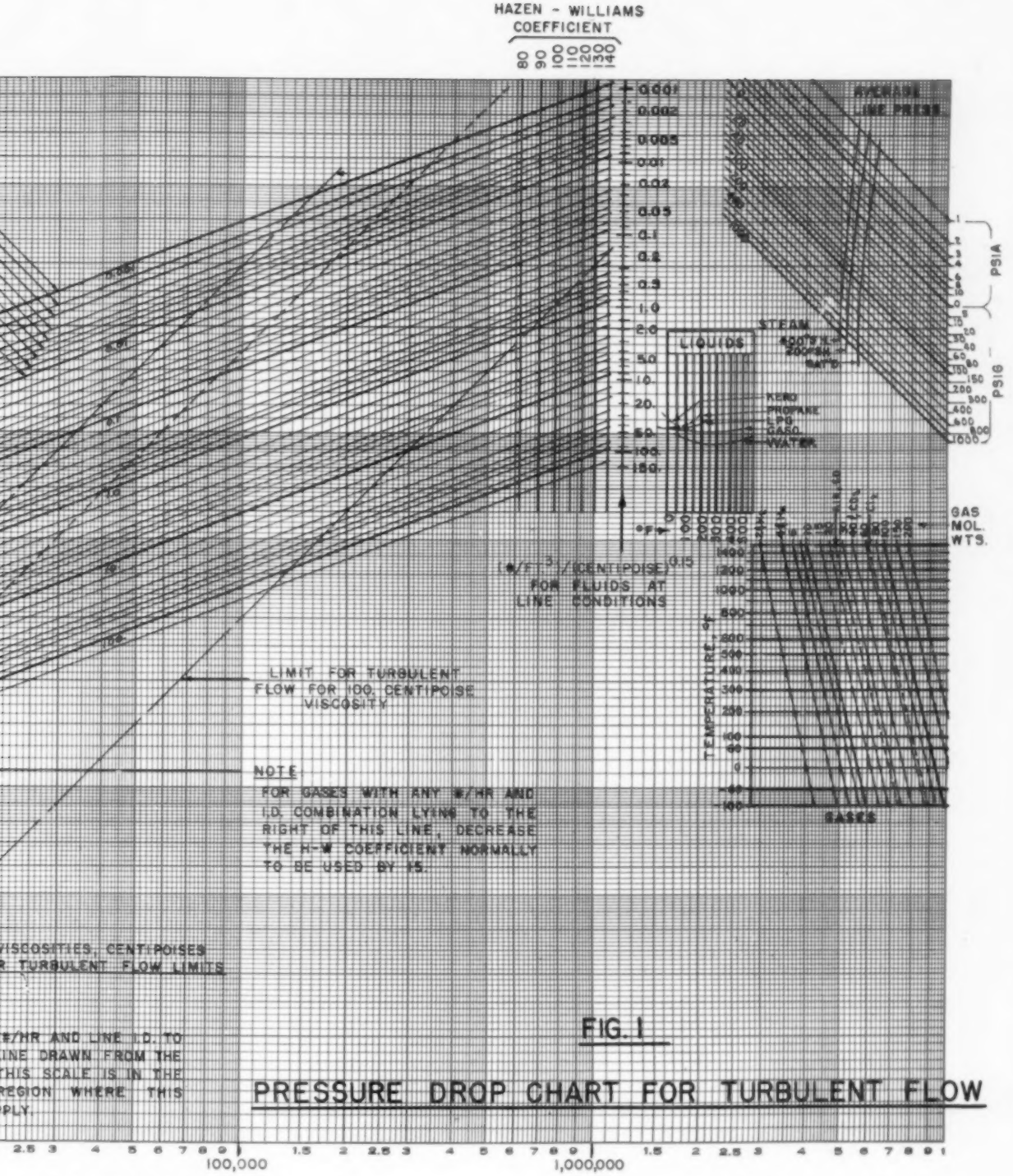


FIG. 1

PRESSURE DROP CHART FOR TURBULENT FLOW

TABLE 1

EQUIVALENT LENGTH

BASIS: 1 Velocity Head = 4

Equivalent length

	Line Size	90° ELBOWS								45° ELBOWS				180° RETURN BENDS			TEES & CROSSES							
																	Straight Run			In Branch-Out Run				In
		Screwed Std.	Screwed Med.	Screwed LR	Weld or Fl., Std.	Weld or Fl., LR	Square	2-Mitre	3-Mitre	Screwed Std.	Weld or Fl., Std.	Weld or Fl., LR	1-Mitre	Screwed Std.	Weld or Fl., Std.	Weld or Fl., LR	Screwed	Weld or Fl.	Fabricated	Screwed	Weld or Fl.	Fabricated	
Schedule 80	1/2	1.7	1.4	1.1	0.8	0.6	-	-	-	0.8	0.5	0.4	-	3.8	1.1	0.8	1.1	0.6	6.9	4.4	2.5	3.6	3
	3/4	2.3	1.9	1.5	1.1	0.8	-	-	-	1.1	0.7	0.5	-	5.	1.6	1.1	1.5	0.9	1.3	6.	3.5	5.	4
	1	3.0	2.5	1.9	1.5	1.1	-	-	-	1.4	1.0	0.7	-	7.	2.0	1.4	1.9	1.1	1.6	8.	4.5	6.	5
	1-1/4	4.0	3.4	2.6	2.0	1.4	-	-	-	1.8	1.3	0.9	-	9.	2.7	1.8	2.6	1.5	2.2	10.	6.	8.	7
Standard Pipe	1-1/2	5.	4.1	3.2	2.5	1.8	10.	-	-	2.3	1.6	1.1	2.5	11.	3.4	2.3	3.2	1.9	2.7	13.	7.	11.	9
	2	6.	5.	4.1	3.2	2.3	14.	-	-	3.0	2.1	1.4	3.2	14.	4.3	3.0	4.1	2.4	3.5	17.	10.	14.	12
	2-1/2	8.	6.	4.9	3.8	2.8	16.	-	-	3.5	2.5	1.7	3.8	17.	5.	3.5	5.	2.9	4.2	20.	12.	16.	14
	3	10.	8.	6.	4.7	3.5	20.	6.	-	4.4	3.1	2.2	4.7	22.	6.	4.4	6.	3.6	5.	25.	14.	21.	17
	4	14.	11.	8.	6.	4.5	26.	8.	-	6.	4.0	2.8	6.	28.	8.	6.	8.	4.7	7.	32.	19.	27.	23
	5	16.	13.	10.	8.	6.	32.	10.	-	7.	5.	3.5	8.	35.	11.	7.	10.	6.	9.	41.	24.	34.	29
	6	19.	16.	12.	9.	7.	38.	12.	9.	9.	6.	4.3	9.	43.	13.	9.	12.	7.	10.	49.	28.	40.	34
	8	-	-	-	12.	9.	50.	16.	12.	-	8.	6.	12.	-	17.	11.	-	9.	14.	-	37.	50.	
	10	-	-	-	15.	11.	60.	20.	15.	-	10.	7.	15.	-	21.	14.	-	12.	17.	-	47.	70.	
	12[a]	-	-	-	19.	14.	80.	24.	19.	-	12.	9.	19.	-	25.	17.	-	14.	21.	-	60.	80.	
	14	-	-	-	21.	15.	90.	26.	21.	-	13.	10.	21.	-	28.	19.	-	16.	23.	-	60.	90.	
	16	-	-	-	24.	17.	100.	30.	24.	-	15.	11.	24.	-	32.	22.	-	18.	26.	-	70.	100.	
Loss in Val. Heads[b]		0.93	0.79	0.6	0.46	0.34	1.9	0.59	0.46	0.43	0.30	0.21	0.46	2.1	0.63	0.43	0.6	0.35	0.51	2.4	1.4	2.0	1

Notes: a. Equals number of pipe diameters for any size (to ± 10 percent).

b. References: Various Manufacturer's Catalogs, such as, Crane, Tube Turn, Nordstrom, Clow-National. These factors multiplied by loss due to velocity head equals the loss in a fitting.

c. Apply only to stream through flow path shown.

d. Equivalent length in feet of pipe to cause same loss as velocity head loss.

e. See special chart (Fig. 4) of valve characteristics at partially open positions.

f. Values for wide open position.

g. Unlined — 2.2; glass lined — 1.3.

BLE 1

GTHS OF FITTINGS

l = 40 inside diameters

ngth in feet

(Tees Only) Run-In Run-Out Branch				LATERALS Screwed or Fab.	LATERALS Weld	ENTRANCE LOSS		EXIT LOSS	VEL. HEAD[d]	VALVES-WIDE OPEN[e]									LINE PROPERTIES		
Fabricated	Screwed	Weld or Fl.	Fabricated	Straight Run	Branch	Ordinary	Borda			Gate	Globe	Angle	Plug	Ventum Plug	Needle	Swing[f] Check	Foot Valve	Saunders, R.L.	GPM at 1 fps.	I.D., Inches	Schedule No.
.6	3.1	1.8	2.7	0.9	1.4	0.9	1.6	1.8	1.82	0.3	18.	9.	1.8	-	20.	4.5	-	5.	0.73	0.55	80
.	4.2	2.5	3.7	1.3	1.9	1.2	2.1	2.5	2.47	0.5	25.	12.	2.5	-	18.	6.	-	7.	1.35	0.74	80
.	5.	3.2	4.8	1.6	2.4	1.6	2.8	3.2	3.19	0.6	32.	15.	3.2	-	22.	7.	-	10.	2.24	0.96	80
.	7.	4.3	6.	2.2	3.2	2.1	3.7	4.3	4.26	0.8	43.	20.	4.3	-	-	10.	-	13.	3.99	1.28	80
.	9.	5.	8.	2.7	4.1	2.7	4.7	5.	5.36	1.0	50.	25.	5.	-	-	13.	8.	16.	6.3	1.61	40
.	12.	7.	10.	3.5	5.	3.4	6.	7.	6.90	1.3	70.	32.	7.	-	-	16.	10.	21.	10.5	2.07	40
.	14.	8.	12.	4.2	6.	4.1	7.	8.	8.24	1.6	80.	39.	8.	-	-	19.	12.	25.	14.9	2.47	40
.	17.	10.	15.	5.	8.	5.	9.	10.	10.24	2.0	100.	48.	10.	-	-	24.	15.	31.	23.0	3.07	40
.	23.	13.	20.	7.	10.	7.	12.	13.	13.44	2.6	130.	60.	13.	-	-	32.	20.	40.	39.6	4.03	40
.	29.	17.	25.	9.	13.	8.	15.	17.	16.84	3.2	170.	80.	17.	-	-	40.	25.	50.	62.	5.05	40
.	34.	20.	30.	10.	15.	10.	18.	20.	20.2	3.8	200.	100.	20.	47.	-	48.	30.	60.	90.	6.07	40
.	-	27.	40.	14.	20.	13.	23.	27.	26.6	5.	270.	120.	27.	60.	-	60.	40.	80.	156.	7.98	40
.	-	33.	50.	17.	25.	17.	29.	33.	33.4	6.	330.	160.	33.	80.	-	80.	50.	100.	246.	10.0	40
.	-	40.	60.	21.	31.	20.	35.	40.	40.	8.	400.	-	40.	90.	-	90.	60.	120.	352.	12.0	Std.
.	-	44.	70.	23.	34.	22.	39.	44.	44.2	9.	440.	-	44.	110.	-	120.	70.	130.	430.	13.3	30
.	-	50.	80.	26.	39.	26.	44.	50.	50.8	10.	500.	-	50.	120.	-	120.	80.	150.	570.	15.3	30
.0	1.7	1.0	1.5	0.51	0.76	0.5	0.87	1.	1.00	0.19	10.	4.7	1.	2.3	-	2.35	1.5	3.[g]			

TABLE 2. Equivalent Lengths of ASA Reducing Fittings

Basis: 1 velocity head = 40 diameters*

Table shows *equivalent feet of smaller diameter.*

DOWNSTREAM LINE SIZE \ UPSTREAM LINE SIZE	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12	14	16
½	—	0.1	0.2	0.4	0.5	—	—	—	—	—	—	—	—	—	—	—
¾	0.2	—	0.1	0.4	0.5	0.6	—	—	—	—	—	—	—	—	—	—
1	1.0	0.4	—	0.2	0.3	0.6	0.7	—	—	—	—	—	—	—	—	—
1¼	1.6	1.4	0.6	—	0.1	0.4	0.6	0.9	—	—	—	—	—	—	—	—
1½	1.9	1.9	1.3	0.3	—	0.2	0.5	0.9	1.1	—	—	—	—	—	—	—
2	—	2.5	2.4	1.6	0.7	—	0.2	0.6	1.1	1.4	—	—	—	—	—	—
2½	—	—	3.0	2.6	1.9	0.6	—	0.2	1.0	1.4	1.7	—	—	—	—	—
3	—	—	—	3.7	3.5	2.4	0.9	—	0.5	1.2	1.7	—	—	—	—	—
4	—	—	—	—	5.0	5.0	3.9	1.8	—	0.5	1.2	2.2	2.8	—	—	—
5	—	—	—	—	—	6.0	6.0	4.9	1.6	—	0.5	1.7	2.8	3.4	—	—
6	—	—	—	—	—	—	7.0	7.0	5.0	1.6	—	1.1	2.4	3.3	3.7	—
8	—	—	—	—	—	—	—	—	9.0	7.0	3.6	—	1.1	2.5	3.2	4.3
10	—	—	—	—	—	—	—	—	12.0	12.0	10.0	3.3	—	1.0	1.8	3.3
12	—	—	—	—	—	—	—	—	—	14.0	14.0	10.0	2.9	—	0.4	1.7
14	—	—	—	—	—	—	—	—	—	—	16.0	13.0	6.0	1.6	—	0.9
16	—	—	—	—	—	—	—	—	—	—	—	18.0	13.0	3.2	2.7	—

Enlarging — Reducing

For eccentric reducers, increase above values by 33%.

For sudden enlargements, use values from table above.

For sudden contractions, use **twice** values from table above.

(For sudden enlargements to diameter ratios not shown, use the entrance loss equivalents for the upstream line size shown on Table 1.

For sudden reductions to diameter ratios not shown, use the exit loss equivalents for the downstream line size shown in Table 1.

For reducing (enlarging) tees, crosses, laterals, or ells, add length of **sudden** contraction (enlargement) to length of the fitting of the same size as the smaller line.

*Number of velocity heads taken from Tube Turns, *Flow of Fluids*, page 8.

TABLE 3. Recommended Pressure Drops

SERVICE	PSI/100 EQ. FT.*	NOTES
Transfer lines, liquids	1.0	
Transfer lines, gases and vapors	0.5	
Centrifugal pump		
suction	0.4	Check NPSH available
discharge	1.	
Reciprocating pump		
suction	(No. Cyls.)÷10	
discharge	(No. Cyls.)÷4	
Reciprocating compressor w/snubbers		
Suction hdr., under 50 psig	0.125	These values may be doubled for centrifugal or rotary compressors. They may be halved where snubbers are not used.
Suction hdr., above 50 psig	0.25	
Suction & discharge leads	0.125	
Discharge header	0.25	
Steam	1.	
Fuel gas headers: spargers	0.125	
Fuel gas takeoffs: sparger takeoffs	0.5	

*Two to three times these values may be used for alloy or other expensive piping except at pump or compressor suctions.

TABLE 4. Hazen-Williams Coefficients for Turbulent Flow

FLUIDS HANDLED	PIPE MATERIAL OR LINING: Old Steel	Old Iron	Stainless Alloy*	New Tubing	Lead, Rubber	Glass
LIQUIDS						
Water	100	110	130	140	110	140
Refined hydrocarbons	120	120	130	140	—	—
Crudes; solvents	100	110	120	140	120	—
Brines	80	90	120	140	110	130
Acids; chlorine	110	110	120	140	110	140
Alkalis	100	100	130	140	—	—
GASES AND VAPORS	125	125	135	130	125	130

*And new steel seamless pipe.

Comparative Inaccuracies

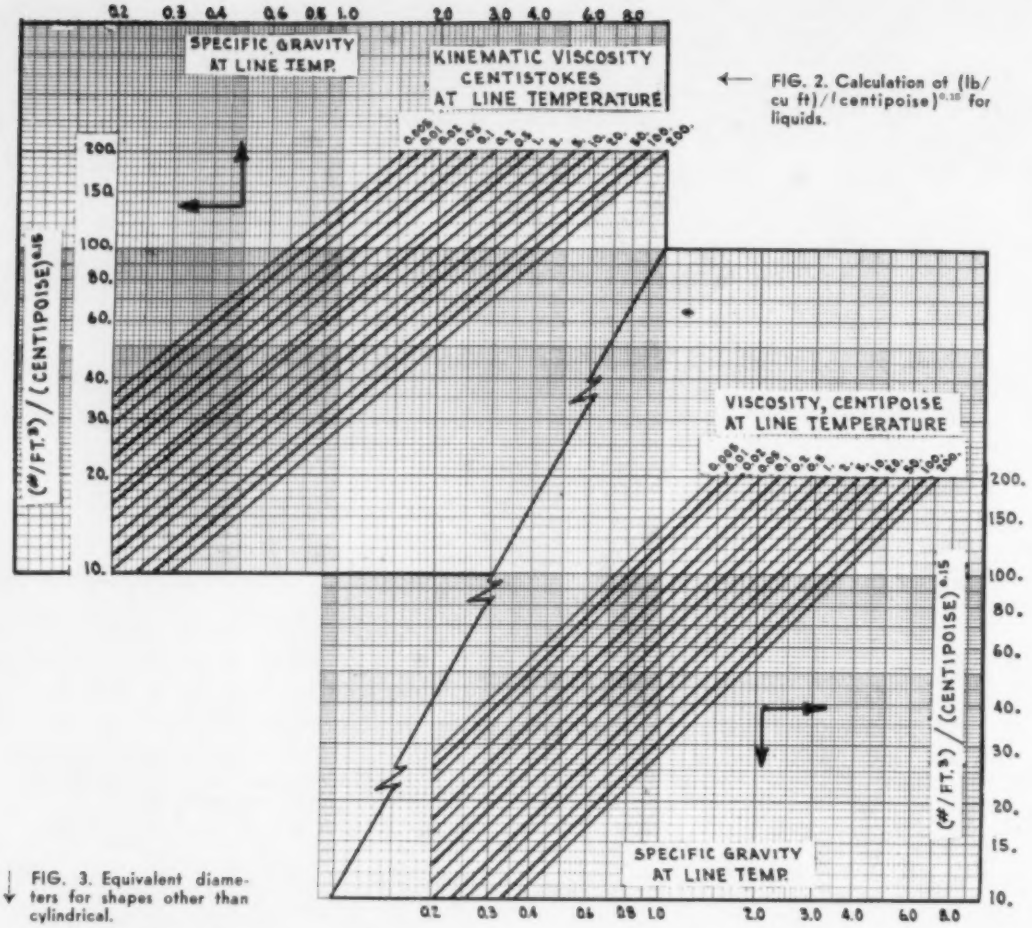
A comparison of pressure loss as calculated by three commonly used methods is given in Table 5, using values obtained from Fig. 1. Examples shown are chosen for fluids with readily identifiable fluid properties. Pressure loss calculations use new steel pipe with a H-W coefficient of 130, unless otherwise designated.

It should be remembered that ΔP approximations are tied to devices such as "roughness factors," "relative roughness," or Hazen-Williams coefficients. The coefficients for application here could be, in the extreme, "sophisticated" until "perfect" checks were obtained with any other method of pressure loss calculation. For the vast majority of "chores," further "sophistication" does not seem warranted.

TABLE 5. Comparison of Methods

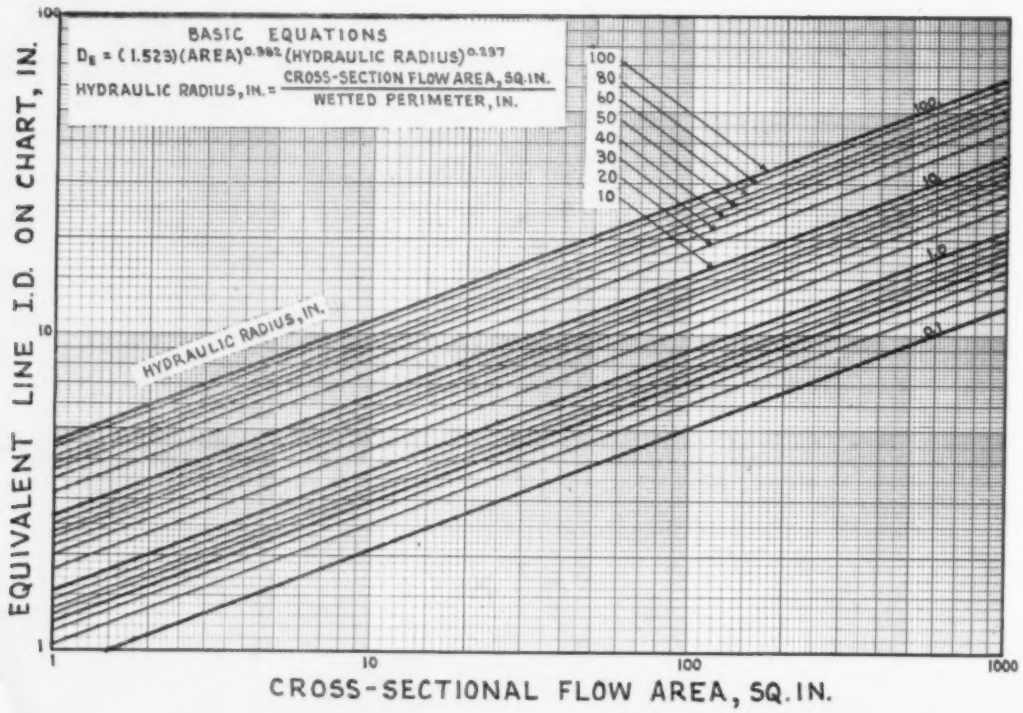
EXAMPLE: Fluid	Flow	Temperature	Line Size	PRESSURE LOSS/100 FT.: FIG. 1	Crane Tech. paper #410	Tube Turn "Flow of Fluids"	NGSMA (1957)
1. Water	100,000 lb/hr	60 F	4 in. sch 40	**1.1**	0.985	—	—
2. Water	200,000 lb/hr	60 F	4 in. sch 40	**3.8**	3.68	3.7	—
3. Water	600 gpm	150 F	6 in. std wt	**1.0**	0.91	1.03	—
4. Water	2000 gpm	60 F	10 in. std wt	**0.85**	0.808	0.83	—
5. Air	7000 SCFM (100 psig)	60 F	6 in. std wt	**1.0**	1.07	1.02	—
6. Natural gas	200 MM SCFD (500 psig at sp. gr 0.9)	90 F	16 in. (0.500-in. wall thickness)	**0.80***	—	—	0.82

*H-W Coefficient = 110 (per instructions Fig. 1).

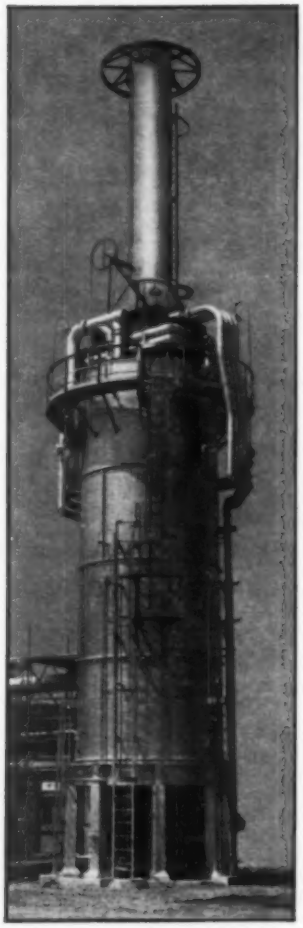

SPECIFIC GRAVITY AT LINE TEMP.
KINEMATIC VISCOSITY CENTISTOKES AT LINE TEMPERATURE
VISCOSITY, CENTIPOISE AT LINE TEMPERATURE
SPECIFIC GRAVITY AT LINE TEMP.
(#/FT.³)/(CENTIPOISE)^0.15

← FIG. 2. Calculation of (lb/cu ft)/(centipoise)$^{0.15}$ for liquids.

↓ FIG. 3. Equivalent diameters for shapes other than cylindrical.


BASIC EQUATIONS
$D_E = (1.523)(\text{AREA})^{0.562}(\text{HYDRAULIC RADIUS})^{0.237}$
$\text{HYDRAULIC RADIUS, IN.} = \frac{\text{CROSS-SECTION FLOW AREA, SQ.IN.}}{\text{WETTED PERIMETER, IN.}}$
HYDRAULIC RADIUS, IN.
EQUIVALENT LINE I.D. ON CHART, IN.
CROSS-SECTIONAL FLOW AREA, SQ.IN.

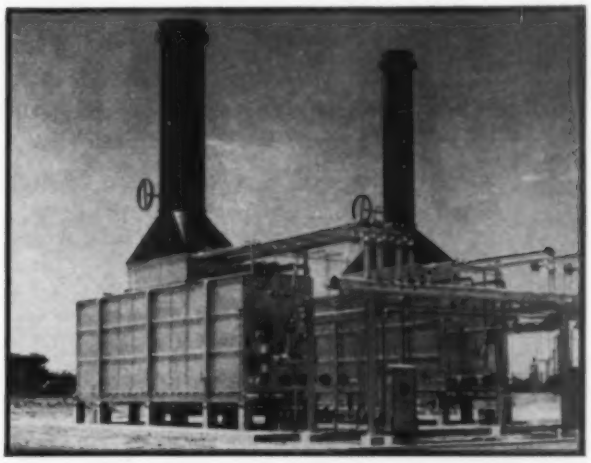
BORN BUILDS BETTER HEATERS



For one thing BORN builds nothing but heaters . . . heaters for every process heating requirement. For over forty-two years BORN has specialized in this field and as a result BORN HEATERS are known for their close control, economical, trouble-free operation plus exclusive safety features not found on any other heaters. During this time BORN HEATERS have built a reputation for producing day after day with no expensive "down-time" for frequent servicing and repairs.

No wonder BORN HEATERS are specified time and time again by clients whose names are the Who's Who of the Oil Industry.

For the complete story on a BORN HEATER to fit your needs, write, wire or call your BORN representative. He's anxious to serve you.



BRANCH OFFICES:
Denver, Colorado; Houston, Texas;
Los Angeles, California;
New York, New York;
Shreveport, Louisiana

IN CANADA:
Canadian Brown Steel Tank Co., Ltd.
Brandon, Manitoba, Canada

IN GREAT BRITAIN:
H. & E. Lintott, Ltd.
Horsham, Sussex, England

IN FRANCE:
Sacama
Paris, France

BORN Engineering Company
Manufacturers of Direct-Fired "UPFLO" Heaters
TULSA, OKLAHOMA

HOW TO USE CHART

To Determine Unknown for Any Gas or Liquid System

1. From the value of $\frac{(\text{lb/cu ft})}{(\text{centipoise})^{0.15}}$ of the fluid at line conditions, go horizontally to the proper Hazen-Williams coefficient.
2. Now proceed parallel to the slant lines to a known (lb/hr) or ID. This point is the (lb/hr) and ID combination for 1.0 psi drop/100 ft.
3. **At a known flow,** find pressure drop at other ID's by going horizontally to any heavy slant line, calling this line 1.0 psi/100 ft, then **up or down** to other ID's. With the above heavy slant line taken as 1.0, the pressure drop may now be read on the log scale of the slant lines.
4. **At a known ID,** find pressure drop at other flows by going vertically to any heavy slant line, calling this line 1.0 psi/100 ft, then **right or left** to other flows where the pressure drop may be read on the log scale of the slant lines.

For Gases Well Away From The Critical Temperature

5. For all gases except steam, go from the average mol. wt. vs average line temperature chart vertically to the average line pressure (½ of inlet pressure plus outlet pressure). For steam, go directly to the steam curves on the line pressure curves.
6. Now go horizontally to the proper Hazen-Williams coefficient, and precede with steps 2 and 3 (or 4) above.

(Note: For gases at temperatures from about 0.5 to 2.0 times the critical temperature, it may be necessary to correct the viscosity and density for temperature and pressure and calculate the proper value of

$$\frac{(\text{lb/cu ft})}{(\text{centipoise})^{0.15}}$$

For Vapor-Free Liquids

7. For the liquids shown on Fig. 1, go from the average line temperature and liquid curve horizontally to the proper Hazen-Williams coefficient. Then proceed with steps 2 and 3 (or 4) above.
8. For liquids not shown, the values of the viscosity (either in centipoises or centistokes) and gravity at line temperature must be determined. Then, Fig. 2 may be used to obtain the value of $\frac{(\text{lb/cu ft})}{(\text{centipoise})^{0.15}}$. Proceed with steps 1, 2, and 3 (or 4) above.

TWO TYPICAL PROBLEMS

PROBLEM 1 — To Determine Line Size

Size a process transfer line to carry a vapor flowing isothermally at 150 F. Molecular weight of vapor is 75 and the operating pressure of the system is 200 psig. Flow is 137,000 lb/hr.

Step 1. Consult Table 3. Recommended allowable pressure loss for vapor transfer lines is 0.5 psi/100 L_e.

Step 2. Enter Fig. 1 on the mol wt vs temperature curve for gases and determine intersection of mol wt 75 at 150 F.

Step 3. From this point proceed vertically to average pressure line (200 psig).

(Note: If line length under consideration is long so that overall pressure loss is large, average line pressure should be used.)

Step 4. Consult Table 4. H-W coefficient for new steel pipe is 125 for vapors.

Step 5. Continue from Step 3 to a H-W coefficient of 125.

Step 6. Proceed parallel to slant lines to a flow of 137,000 lb/hr. Since this point lies to the right of 45° dotted line on Fig. 1, reduce the H-W coefficient by 15. Repeat Steps 5 and 6.

Step 7. Read line ID of 8.0 for a pressure loss of 1 psi/100 L_e.

Step 8. Go horizontally to the left or right to the first heavy slant line reached. Note that this is still 1 psi/100 L_e in an 8.0 in. ID line.

Step 9. From this point vertical travel **up** is <1.0; vertical travel **down** >1.0. Since the 8-in. line gives twice the allowable drop, select a 10-in. std wt line. Proceed vertically up to the intersection with the 10-in. std wt line and read 0.35 psi/100 L_e, which is <0.5 psi allowed.

PROBLEM 2 — To Determine Pressure Loss

Assume the same conditions as above in problem 1 except line size is known to be 6-in. std wt and determine pressure loss for the flow given.

Step 1. Repeat Steps 2, 3, 4, and 5 above.

Step 2. Proceed parallel to slant lines to a line diameter of 6-in. Correct H-W coefficient as noted and repeat. Read flow to be 64,000 lb/hr. This is the flow of this vapor in a 6-in. line to give 1.0 psi/100 L_e.

Step 3. To find the pressure loss corresponding to 137,000 lb/hr, move up or down to the first heavy slant line encountered and then proceed horizontally to a flow of 137,000 lb/hr. Read $\Delta P = 4.0$ psi/100 ft L_e.

Dr. McMahon *received his education at Rice Institute (BS chemical engineering) and the University of Texas where he obtained his doctorate in chemical engineering in 1950. He taught chemical and mechanical engineering as well as mathematics at the University of Texas. He has been associated since 1949 with Wyatt C. Hedrick Engineering Corporation where he is now chief chemical engineer. Dr. McMahon has had broad experience in refining, petrochemical and inorganic process design, having worked on chlorine, caustic, chlorinated hydrocarbons, sulfides, styrene, natural gasoline, catalytic cracking, reforming, butadiene, and utility systems.*

Presently chairman-elect of the South Texas Section of the AIChE he is also a member of the ACS, Tau Beta Pi, Phi Lambda Upsilon and the Houston Engineering and Scientific Society. He is a registered professional engineer in Texas and a member of the Texas Society of Professional Engineers.

J. C. Webb *was graduated in 1951 with distinction from Oklahoma State University where he received a BS in chemical engineering.*

From 1951 until 1955 he worked for Dow Chemical Company as production supervisor, design engineer, process engineer and the last two years as a project engineer. Since that time he has been associated with C. F. Braun & Company in California as project chemical engineer; Brown & Root, Inc., Houston; Wyatt C. Hedrick Engineering Corporation, Houston, as a senior project engineer; J. C. Webb & Associates, Houston, consultant. At present, he is editor of Refining Engineer *with offices in Dallas where he manages all editorial functions of the publication.*

His experience includes work in operations, maintenance, design, and construction. He is a registered professional engineer in Texas and a member of the Texas Society of Professional Engineers.

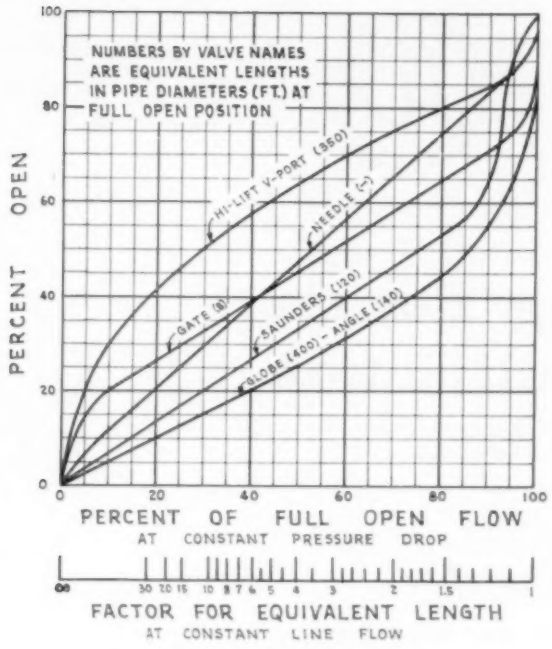

NUMBERS BY VALVE NAMES ARE EQUIVALENT LENGTHS IN PIPE DIAMETERS (FT.) AT FULL OPEN POSITION
HI-LIFT V-PORT (350)
NEEDLE (∞)
GATE (8)
SAUNDERS (120)
GLOBE (400) - ANGLE (140)
PERCENT OPEN
PERCENT OF FULL OPEN FLOW AT CONSTANT PRESSURE DROP
FACTOR FOR EQUIVALENT LENGTH AT CONSTANT LINE FLOW

FIG. 4. Flow characteristics of hand valves.
— Basic data from Minneapolis-Honeywell Bulletins 242-1 and Hills-McCanna Catalog V-50.

Quite often line size determinations are not clear cut and they must be based on trial and error calculations and economic considerations. This alignment chart offers a rapid method for the trial and error calculations of various line sizes and the resultant unit pressure losses that must be considered.

SHORT CUTS

Shapes Other Than Cylindrical

Use "equivalent line ID" from Fig. 3. This D_e may be used in the equations below or directly on Fig. 1.

Equivalent Length of One Diameter In Terms of Another

Length L_1 of diameter D_1, equivalent to L_2 of D_2, is found by:

$$L_1 = L_2 \left(\frac{D_1}{D_2}\right)^{4.85} \quad . \ . \ . \quad (3)$$

Example: A 6-in. gate valve (L_e = 3.8 ft from Table 1) is equivalent to $(3.8)\left(\frac{12.0}{6.07}\right)^{4.85} = 103$ ft of 12-in. pipe

Lines of Different Size in Series

It is often convenient to express a system as equivalent feet of a specific diameter; for L_1 of D_1, L_2 of D_2 and L_3 of D_3, all in series with the same flow rate in each length, check for turbulent flow in each section, then:

$$\text{Total line (as } L_e \text{ of } D_1) = L_1 + L_2\left(\frac{D_1}{D_2}\right)^{4.85} + L_3\left(\frac{D_1}{D_3}\right)^{4.85} \quad . \ . \ . \quad (4)$$

Lines of Different Size in Parallel

Note: Each line must be at the same source pressure and end pressure as the other.

1. First express each line as equivalent feet of one diameter: For two vessels connected by L_1 of D_1 and L_2 of D_2, consider the lines as L_1 of D_1 paralleled by

$$L_2' \text{ of } D_1 = L_2\left(\frac{D_1}{D_2}\right)^{4.85} \quad . \ . \ . \quad (5)$$

This L_2' is the length of line of diameter, D_1, which will have the same flow capacity as L_2 feet of D_2.

2. The two lines together are equivalent to a single line carrying the total flow: the feet of D_1 equivalent to the two parallel lines is:

$$L_t = \frac{L_1}{\left[\left(\frac{L_1}{L_2'}\right)^{0.54} + 1\right]^{1.85}} \quad . \ . \ . \quad (6)$$

3. The total flow is split between the two lines:

$$\left(\frac{W_2}{W_1}\right) = \left(\frac{L_1}{L_2'}\right)^{0.54} \quad . \ . \ . \quad (7)$$

4. Check for turbulent flow in both lines.

Example: 3800 equivalent feet of 12-in. line is paralleled by 1000 equivalent feet of 6-in. line carrying water from a pump to a drainage ditch.

The 6-in. line is equivalent to:

$$(1000)\left(\frac{12.0}{6.07}\right)^{4.85} = 27{,}000 \text{ ft of 12-in. line.}$$

The two parallel lines are equivalent to:

$$\frac{3800}{\left[\left(\frac{3800}{27{,}000}\right)^{0.540} + 1\right]^{1.85}} =$$

$$\frac{3800}{[0.346 + 1]^{1.85}} = 2200 \text{ ft of 12-in. line}$$

The 6-in. line carries

$$\frac{0.346}{(1 + 0.346)}(100) = 26\% \text{ of the total flow}$$

Ratioing Pressure Losses Through Equipment and/or Piping Systems

(Caution: *The condition of turbulent flow cannot be checked throughout a system by the usual chart methods.)*

Same Fluid Flowing at Different Rates:

At the known flow, locate the known pressure loss on the scale of slant lines. Proceed horizontally to other flows and read the corresponding pressure drops on the slant line scale.

Different Fluid at Different Rate Through Same System:

First find the line ID for 1.0 psi/100 ft with the first fluid at its known flow. Calculate the length of this size line that would be required to give the known pressure loss with the first fluid.

Then find pressure loss for the new fluid at its new flow through the same length of line with the same ID.

Example: An exchanger shell side used on water (100 F average temperature) gave 10 psi loss at 10,000 lb of water/hr. The exchanger is found to be equivalent to 1000 ft of 1.84-in. ID pipe, H-W coefficient = 100. If used on air at 50 psig, 200 F average, with an air rate of 1000 lb/hr, the pressure drop (H-W coefficient = 125) would be about 13 psi. ★ ★ ★

These field tests indicate that . . .

Aluminizing Resists Refinery Sulfidation and Oxidation

Observation Results on

1. Dipped

2. Sprayed

3. Sprayed and Heat Diffused Aluminized Coatings

G. F. Tisinai
C. H. Samans
Standard Oil Company of Indiana
Whiting, Indiana

Sulfidic Corrosion Reaction

Severe sulfidic corrosion by hydrocarbon atmospheres containing hydrogen sulfide-hydrogen mixtures was first encountered in reforming units [1] and in preliminary work on hydrogenation units.[2]

Under refinery conditions, the basic corrosion reaction is:

$$Fe + H_2S \rightleftarrows FeS + H_2$$

Thermodynamic Cutoff

Because the reaction is reversible, the specific hydrogen sulfide and hydrogen concentrations will determine the rate of corrosion. In fact, at any temperature, there is a specific hydrogen sulfide: hydrogen ratio above which corrosion occurs and below which corrosion does not occur. This relationship, which has been determined by T. Rosenqvist,[3] is known as the thermodynamic cutoff. A. Dravnieks and C. H. Samans [4] have given the rates of corrosion above the thermodynamic cutoff as a series of iso-corrosion curves relating corrosion rate, temperature, and hydrogen sulfide: hydrogen ratio.

Effect of Pressure

In the absence of oxygen, which can alter these corrosion rates significantly, corrosion at a pressure of 300 psia should be approximately three to four times as great as at atmospheric pressure.

Methods of Control

The data also indicate that sulfidic corrosion under these conditions can be controlled by desulfurizing the feed to a low enough level. A sulfur level suitable for reformer operation is readily attainable. However, sulfidic corrosion in reforming also can be controlled by the use of aluminum coatings. This method is appreciably less expensive than the use of austenitic stainless steels.

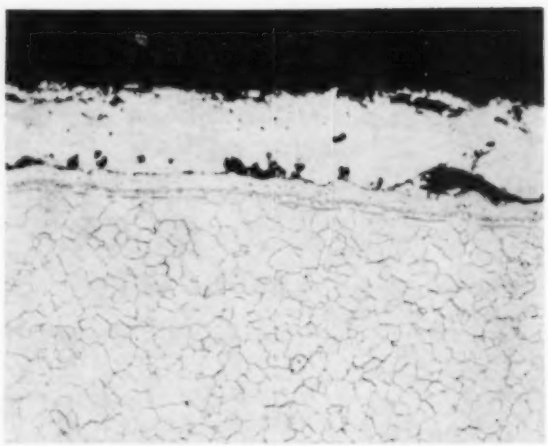
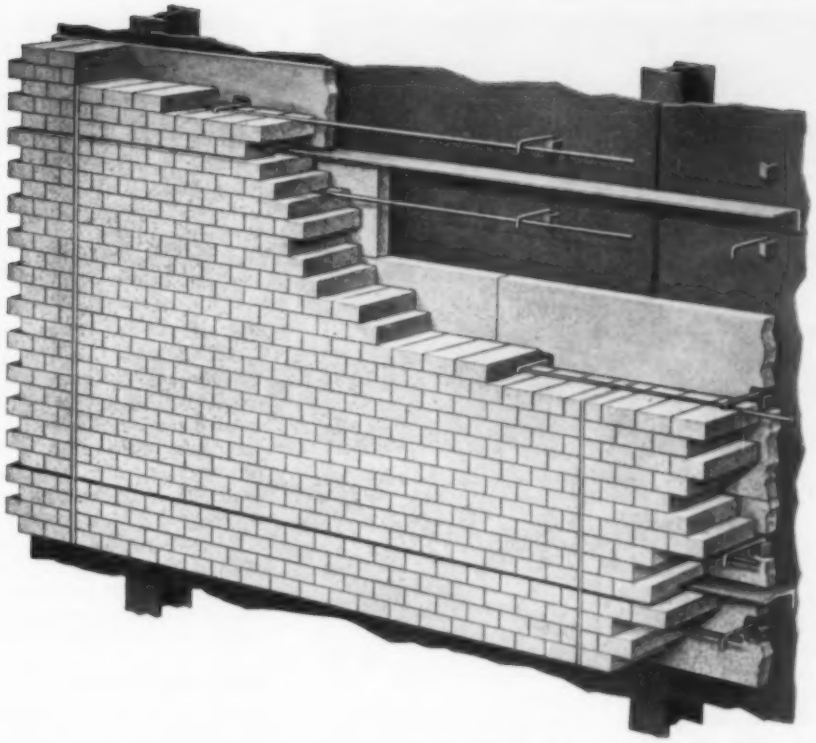


FIG. 1. A typical section through a carbon-steel tube which was calorized commercially (150 X). Notice the nearly complete removal of carbon from the steel base metal.

Similarly, sulfidic corrosion can occur in other units such as cokers and pipe stills. As-sprayed aluminum coatings have been used to overcome this type of corrosion, but not always successfully. To improve the effectiveness of aluminum coatings, limited work has been done on diffusion heat treatment of such sprayed equipment in the field.

Early aluminizing of refinery equipment was confined almost entirely to the well-known calorizing process and to the, at that time, lesser known aluminum-dipping process. Aluminum coatings had been sprayed on a few vessels in an effort to secure increased corrosion resistance, but these attempts had met with varying success largely because of

Adapted from paper presented by A. Dravnieks, Standard Oil Company (Indiana), to a session on corrosion during the 24th Midyear meeting of the American Petroleum Institute's Division of Refining, New York, May 1959. Permission of the API Division of Refining to publish this paper is gratefully acknowledged.



B&W Insulating Firebrick sectionally supported wall construction, horizontal rod-type anchoring

Can this construction cut your costs?

Simplified design and lower material costs in initial construction, ease of installation and maintenance, reduced downtime and economy of operation—these are the benefits of this *lightweight* insulating firebrick construction.

Here's what lightweight means. Compared with dense fireclay refractory materials that weigh from 125 to 140 lb per cu ft, lightweight insulating firebrick weigh approximately 26 lb per cu ft for B&W's 2000 degree brick. This difference provides two major advantages: (1) mechanical, which largely affects design and construction, and (2) thermal, which saves in maintenance, downtime and operation.

Savings in design and construction

The use of lightweight IFB simplifies engineering requirements and reduces costs. A minimum of detailing is needed, since the design is engineered around one standard shape — a feature of B&W IFB constructions.

Material requirements are simplified, too. B&W IFB can be tailor-cut, drilled or shaped as necessary, eliminating the need for costly special fired shapes, and the delays in obtaining them. Typical sections, such as burner openings, observation ports and tube supports, can be cut and shaped on the job in minutes, using ordinary woodworking tools.

Substantial savings are possible in structural steel, since insulating firebrick roof and wall constructions are lighter. In locations with soil of poor load bearing capacities, this lightweight may also result in reduced foundation costs.

These savings, coupled with B&W's engineering and service facilities available during the design phase, mean lower initial costs.

Savings in maintenance, downtime and operation

Lightweight IFB offer a major thermal benefit—they store and conduct less heat. Heavy refractories retain heat; in the event of forced shutdown, they can cause burn-out of expensive alloy tubes, where used. The low quantity of heat stored by B&W IFB can be quickly dissipated, thus protecting these expensive tubes.

Further, this low heat storage permits faster heating and cooling. This means quicker access to the furnace in the event of emergency shutdown. Your maintenance crew can get in the furnace sooner and get it back on stream faster.

Supplied from nearby warehouses

With the use of simplified IFB constructions, refractory repairs can be quickly and easily accomplished with standard shapes from a nearby warehouse. This eliminates costly delays in obtaining special shapes.

Anchoring devices, too, are simplified. Since there are no expensive special castings in B&W IFB constructions, carbon steel or low alloy rods can be used. These are generally available from any local steel warehouse.

Increased efficiency

Generally, the lighter a firebrick the better an insulator it is. Since B&W IFB are the lightest insulating firebrick made, they are the most efficient insulators. Per inch of thickness, B&W IFB provide more insulation than any other refractory material. The result is that for walls of equivalent thickness less heat is lost with B&W IFB. Casing temperatures are lower, thus improving working conditions. This means increased efficiency and reduced operating costs.

R 838

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

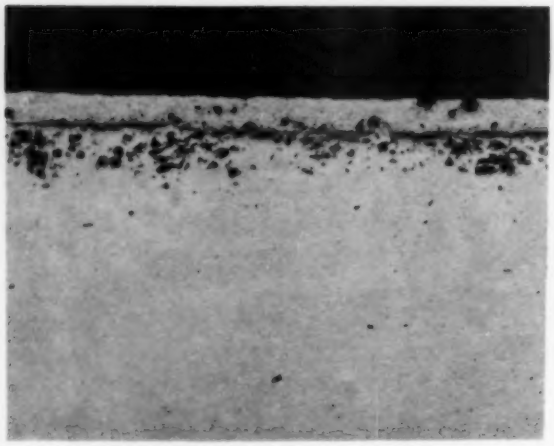


FIG. 2. A typical section through an aluminum-dipped carbon steel (150 X).

unreliable adherence. Many refiners disliked calorized parts because the protective layer was relatively thick, quite brittle, and often tended to spall. On the other hand, numerous valves and fittings coated by dipping were quite successful, although in a few large parts, in which uniform heating rates could not be maintained, distortion caused some problems.

For dipped coatings several different procedures are used, some of which are patented. In a typical procedure, the parts are preheated in the presence of a molten flux and then dipped into a molten bath of aluminum whose impurity content is controlled to a limited extent. A diffusion bond of a brittle, aluminum-iron compound is formed between the ferrous base metal and the aluminum surface layer. Control of the time and temperature of dipping readily controls the thickness of this bond layer on small parts; however, with large parts, which inherently will have a high heat content, proper control may be a problem. It is considered desirable to keep the bond layer as thin as possible because, as the bond layer thickens, its tendency to crack and spall under some conditions increases. The resistance of both the aluminum left on the surface and the alloy bond layer to sulfidic corrosion is quite satisfactory.

The cost of dip coating usually is determined by the weight of the part being dipped. Thus, for heavy valves and fittings (headers weighing as much as 1800 lb have been used in some refineries), this cost often is high, even though the actual surface which must be coated my be of relatively limited extent.

Internal Coating Problems

In addition, because the baths available are not large enough to take care of tubes or lines of any appreciable length, the dip method is not well suited to the internal coating of furnace tubes and transfer lines. Such lines frequently are sources of scale formation, even though their actual corrosion rates may not be too high. Even the alternative of dipping the tubes from each end has not been very attractive because tube length still is restricted to approximately 15 ft to 20 ft. Also, it is difficult to obtain a clean, dross-free, completely coated internal surface consistently on even a relatively large-diameter tube.

Internal Spray Applications. A few companies which spray metals have become interested in the technique of spraying tubes internally. However, even though various methods of surface preparation or undercoating may be used to increase adherence, the basic adherence of an as-sprayed coating still is entirely mechanical. Therefore, to increase the adherence of these sprayed coatings, they are heat-treated at temperatures approximately 50 F to 100 F above the melting point of aluminum to develop an aluminum-iron alloy bond. Studies have been made on various methods of treating tubes after spraying, on spraying tubes externally to increase oxidation resistance, and on spraying refinery vessels internally to secure increased corrosion resistance.

Typical sections through coatings made by calorizing and by aluminum dipping are shown in Fig. 1 and 2, respectively. A section through a typical sprayed and heat-diffused aluminum coating is shown in Fig. 4.

Use of As-Sprayed Coatings

The technique of spraying aluminum on steel surfaces **requires careful surface preparation** to obtain a good mechanical adherence of the aluminum to the steel. Although much experience has now been obtained by some spraying companies, there are newcomers who are spraying coatings for these particular applications who may not be completely aware of all of the precautions required. Even if a very adherent aluminum is placed on steel in the shop, this coating is subject to damage if **proper handling precautions** are not observed during shipment. **Detailed engineering standards are desirable** to govern the surface preparation, aluminum wire quality, procedure of metallizing, post-metallizing sealing, and diffusion heat treatment.

Early Application

One of the first refinery applications of spray aluminizing was in carbon-steel coke drums of a pipe still, the aluminum coating being used in the as-sprayed condition. This unit was built in 1940 and was run without corrosion protection in the drums until 1944. Then all four drums were strip-lined with 11 to 13 percent chromium stainless steel. Within two years of service,* some sections of the strip lining started to give trouble and, by 1954, required extensive repairs. Therefore, portions of the liners were removed and spray aluminizing was used for repair in three of the drums. Approximately 400 sq ft of surface was spray-aluminized in each of two drums and 530 sq ft in a third drum.

The procedure used for repair was:

1. Heat the drums gradually to approximately 500 F

*All service times given are unit hours onstream. The hours the drum operates would be on the order of half of this.

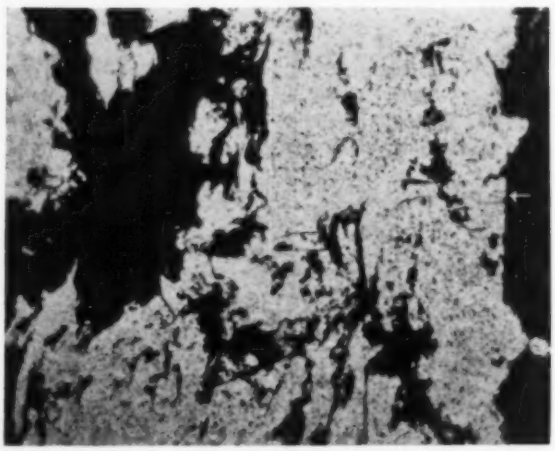


FIG. 3. Mechanical decoking caused fissuring and removal of the aluminum layer of an as-sprayed, heat-diffused coating from a furnace tube. Particles of the iron-aluminum alloy (arrow) also are visible (500 X).

another
TRETOLITE SERVICE
report

THESE USE-PROVEN PRODUCTS CUT MANUFACTURING AND MAINTENANCE COSTS

TRET-O-LITE* *Demulsifiers*

TRET-O-LITE Demulsifying Chemicals separate an aqueous phase from a hydrocarbon phase, or vice versa.

Separation procedure consists simply in mixing a small proportion of the selected TRET-O-LITE with the emulsion and providing suitable storage where the oil and water can separate.

TRET-O-LITE Demulsifiers are used to treat tank "bottoms," also Bunker "C" fuels for the removal of salts and trace metals to permit the use of such fuels in gas turbines.

TRET-O-LITE* *Chemical Desalting*

TRET-O-LITE Chemical Desalting removes harmful salts from crude oil in the 95% to 100% efficiency range, and is currently being used to process over 1½ million barrels of crude daily. Chemical costs average 1.3 mills per barrel.

Experienced Tretolite refinery service engineers inspect construction, supervise start-up and make periodic inspections of the Tretolite desalting equipment. It can be purchased, rented, rented with option to purchase, or constructed by the refiner according to plans furnished by Tretolite.

KONTOL* *Corrosion Inhibitor*

KONTOL Corrosion Inhibitor is a liquid organic semi-polar compound, available in various formulas. It adsorbs onto metal surfaces to form impervious corrosion-inhibiting film. KONTOL Corrosion Inhibitors prevent corrosion in hydrocarbon distillation systems by protecting against attack by chlorides, sulfides, organic acids, other corrosive agents and hydrogen blistering. They also have effective detergent properties at temperatures above those considered normal for this type of inhibitor.

TOLAD† *Fuel Additives*

TOLAD Fuel Oil Additives are ashless, totally oil-soluble compounds designed to enhance the stability of domestic heating oil and diesel fuels, as regards color and residue. These additives exhibit excellent water tolerance characteristics reducing sludge formation and loss to water bottoms in fuel storages. They are available as inhibitor or inhibitor-dispersant formulations.

KUPLEX* *Metal Deactivator*

KUPLEX Metal Deactivator prevents the pro-oxidant effects of copper and its compounds from causing the degradation of petroleum distillates. It prevents degradation reactions by tying-up the dissolved metal as an inactive stable chelate. At concentrations as low as 8 ppm it can reduce anti-oxidant requirement and assure fuel stability. It is effective in gasoline, kerosine, jet fuel, diesel fuel, furnace oil and turbine oil.

TRET-O-LITE* *Water De-Oilers*

The disposal of refinery wastes often results in the loss of valuable refined products, may also lead to the creation of a stream pollution nuisance. Many refiners use TRET-O-LITE Water De-Oilers to correct such problems. The efficient demulsification of waste oil emulsions often makes possible the salvage of large quantities of oil, as well as the lessening of the pollution problem. Tretolite chemicals are in daily use for reclaiming oil from slop disposal systems and separator traps.

For complete information on these, or any Tretolite Company product or service, *ask the Man in the Red Car,* or write

AR-59-1

*TRET-O-LITE, KONTOL *and* KUPLEX *are registered trademarks of Petrolite Corporation*

†TOLAD *is a Petrolite Corporation trademark, registration pending*

PETROLITE
CORPORATION

TRETOLITE COMPANY
DIVISIONS
[illegible] Marshall Avenue, Saint Louis 19, Missouri
5615 Telegraph Road, Los Angeles 22, California

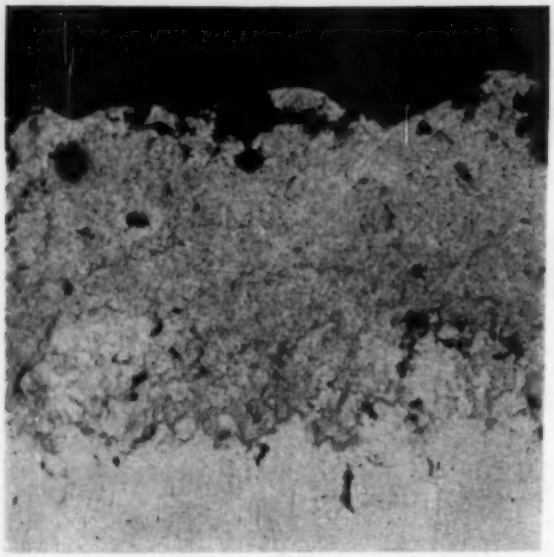
CANADA: Petrolite Corporation of Canada, Limited, 309 Alexandra Bldg., Edmonton, Alberta

ENGLAND: Petrolite Limited, 46 Mount Street, London, W. 1.

VENEZUELA: South American Petrolite Corporation, Hotel Avila, Caracas

REPRESENTATIVES

BRAZIL: WERCO, Ltda., Avenida Rio Branco 57-s/1410-11, Rio de Janeiro
COLOMBIA: South American Petrolite Corporation, Calle 19, No. 7-30, Office 807, Bogota
GERMANY: H. Costenoble, Guiollettstrasse 47, Frankfort, a.M.
ITALY: NYMCO S.p.A. 9, Lungotevere A. da Brescia, Rome
JAPAN: Maruwa Bussan KK, No. 3, 2-Chome, Kyobashi, Chuo-Ku, Tokyo
KUWAIT: F. N. Dahdah, Box 1713, Al Kuwait
MEXICO: R. E. Power, Sierra de Mijes, No. 125, Mexico, D. F.
NETHERLANDS: F. E. C. Jenkins, Hoefbladlaan 134, The Hague
PERU: International Gas Lift Company, Apartado 71, Talara
TRINIDAD: Neal and Massy, Ltd., Port of Spain, P.O. Box 544



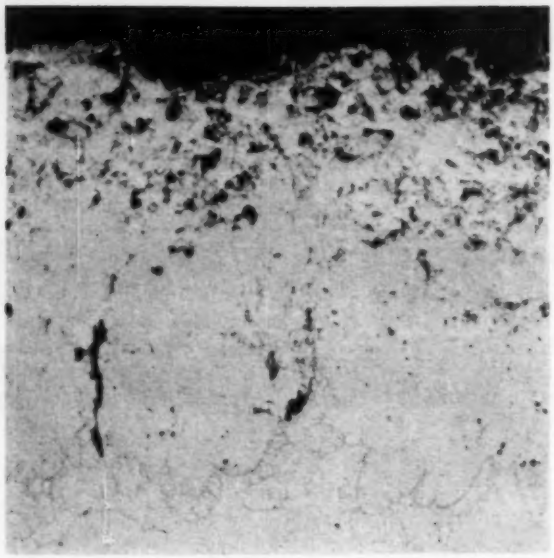


FIG. 4. The picture on the left illustrates the appearance of a sprayed aluminum coating which was diffused for 15 min at 1300 F, whereas that on the right illustrates the appearance after an additional 2 hours of heating at 1300 F. Notice how the alloy bond layer has increased in thickness and the free aluminum layer at the top surface has decreased in thickness (100 X).

and hold for 6 hours to drive off oil vapors and moisture.

2. Sandblast and back-fill with weld metals all corroded areas deeper than ⅛ in.
3. Gritblast all steel surfaces thoroughly with size G-16 steel grit.
4. Apply a flash coat of spray-metallized mild steel (to increase adherence) approximately 0.001 in. thick.
5. Spray on pure aluminum to the desired total thickness of 0.010 in. to 0.020 in. (five to seven coats as a rule, although in some regions thickness was not known too accurately).
6. Paint with two coats of silicone aluminum sealer, with a minimum drying time of 30 min between coats.

The experience to date on these coke drums indicates that a service life of approximately 18 months for a spray-metallized and sealed aluminum coating is possible, provided surface preparation is adequate and clean conditions are maintained while the coating is being applied. Even though the bond is only mechanical in these coatings, it has been shown repeatedly that adherence can be good. It must be recognized that metallized coatings have definite limitations for applications such as this, particularly since a diffusion heat treatment is not used. **If spalling occurs,** corrosion could lead to thinning of the vessel wall in that region. **Nevertheless, for this application, aluminizing appears to be the least expensive type of corrosion protection presently available.**

Pressure stills. As-sprayed aluminum coatings also were placed on the internals of vessels of two continuous pressure stills. All the procedures used in aluminizing were similar, and all of the coatings failed in approximately the same manner. The unit had operated approximately 4377 hours when it next was examined about two years later. At this time the metallized area was gritblasted to remove the coke and any loose aluminum. Approximately 35 percent of the original metallizing had spalled in service or was removed by the gritblasting. In the 30-in. wide area between the two top doughnut baffles all of the metallizing was removed by the blasting.

Apparently, in the deteriorated regions, oil vapors penetrated the pores of the coating and were converted into coke by thermal cracking. This eventually both opened up the aluminum coating internally and separated it from the steel. Ultimately, the separation became sufficient to allow the vapors to cause sulfidic corrosion of the steel shell in the 35 percent defective area. On the other hand, the intact metallized coating on the remaining 65 percent of the area appeared to have resisted the corrosive environment and to be as thick as it was when applied originally.

In another vessel, approximately 12 ft of the upper 15 ft of the vessel (8 ft above and 4 ft below a 5½-in.-thick shell-transition section) was aluminized. After two years of service, the entire surface appeared to be covered by a coke deposit.

An examination indicated that oil vapors had penetrated the pores of the coating and has been converted to coke by thermal cracking. **The deposited coke completely separated the aluminum coating from the steel.** Thus, for this application, an as-sprayed aluminum coating **was not completely satisfactory.**

Use of Sprayed, Heat-Diffused Aluminum Coatings

Test specimens. An aluminum-sprayed and heat-diffused tube, an aluminum-dipped tube, a calorized tube, and a Type 304 stainless tube were placed on test in the reheat furnace of a regenerative platinum catalyst reformer. The rest of the tubes in this furnace, 8 in. OD by 0.400 in. minimum wall, were of 2¼ percent chromium-1 percent molybdenum alloy. At the last inspection, these tubes had been in service for 17,620 hours — 8398 hours without desulfurization of feedstock (uncoated tubes corroded at a rate of 0.040 in. per year), and 9222 hours with desulfurization of feedstock (uncoated tubes corroded at a rate of 0.010 to 0.020 in. per year).

Results. At this time, the Type 304 stainless-steel tube was not affected. The calorized tube showed no evidence of

either corrosion or spalling. The aluminum-dipped tube (dipped from each end, leaving the coated areas with considerable dross and an uncoated, 8-ft long center area which corroded at the normal rate) was in good condition, with the dross still visible, except for a few small areas adjacent to welds where the aluminum coating had spalled. **The aluminum-sprayed and heat-diffused tube had not corroded,** and its aluminum coating still was intact except for a few spalled areas near the weld. On the inside surface of each of these four tubes there was a thin, dull-black surface deposit of unknown nature.

First major installation. In the preheat and the three reheat furnaces of another regenerative platinum catalyst reformer 128 spray-aluminized and heat-diffused tubes, 6 in. OD by 0.3125 in. minimum wall and of 2¼ percent chromium-1 percent molybdenum alloy, were used. This was the first major installation of spray-aluminized, heat-diffused tubes; and conditions were far from ideal during the cleaning, aluminum spraying, and diffusion heat treatment stages of the coating process. Nevertheless, visual inspection of the tubes after 15,728 hours of service revealed only two small spalled areas, both of which had been noted soon after installation and neither of which had grown significantly since. Test coupons which did not have an aluminized surface showed corrosion rates on the order of 0.013 to 0.023 in. per year, depending upon the location.

Reformer desulfurizer furnace. Carbon-steel tubes, 5-9/16 in. OD by 0.258 in. minimum wall, in a reformer desulfurizer furnace at another refinery were corroding at a rate as high as 0.086 in. per year. Therefore, in August 1956, 40 of the lower row radiant roof and wall tubes were replaced with 5 percent chromium-½ percent molybdenum tubes, 5½ in. OD by ⅜ in. average wall and approximately 40 to 44 ft long, which had been pickled, spray-aluminized, and heat-diffused. In November 1956, after 1679 hours of service, the tubes were turbined with the use of dull tools to remove coke; in August 1957, after a total of 7416 hours of service, they were again turbined.

At this time visual examination indicated that 80 to 90 percent of the aluminum coating (as judged by color alone) had been removed. Fig. 3 shows the severe fissuring and deformation of the aluminum coating caused by mechanical decoking, as well as some aluminum-iron alloy particles which were produced by the diffusion heat treatment. After an additional 7114 hours of service, an inspection revealed that very little corrosion had occurred. This **lack of corrosion** is attributed to the protection offered by the **aluminum-iron alloy bond layer** which had not been removed by the turbining.

Delayed coking pipe still. Two externally aluminized and heat-diffused 5 percent chromium-½ percent molybdenum tubes were installed in the lower roof section of each of the two furnaces in the delayed coking section of a pipe still. **Previously, these roof tubes had to be replaced in as short a time as 18 months to two years because of excessive oxidation.** After 3450 hours (September 1958) of operation the **aluminum coatings were found** to be in relatively **good condition.** There were a few localized areas of spalling on the underside of the tubes, but this was considered to be unimportant because the coatings had been diffused. Small bright and shining droplets or globules of aluminum also were found to be hanging from the bottom of the tubes. This indicates that some of the aluminum had melted, probably during a recent onstream decoking operation. **Although these results look promising, service experience still is insufficient** to determine whether or not the oxidation resistance of the aluminized tubes will be better than that of the plain 5 percent chromium-½ percent molybdenum tubes.

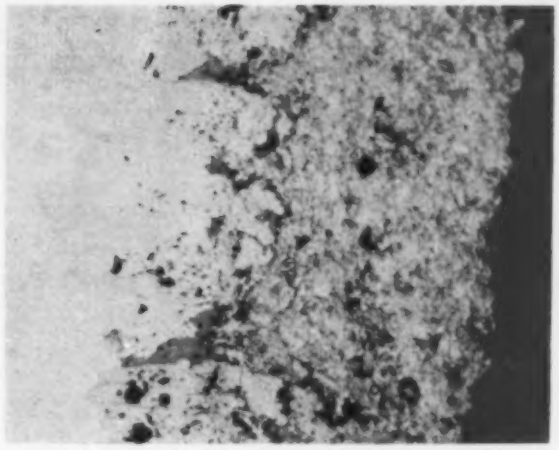


FIG. 5. The metallographic appearance of the aluminized coating after being held for 96 days in a furnace which was maintained at approximately 1300 F. A good portion of the heavy coating of aluminum still is present, thus the steel has been protected from Oxidation (100 X).

Sprayed Aluminum Coatings on Pressure Vessels

Since the feasibility of diffusion heat treatment of sprayed aluminum coatings on the inside and/or the outside of furnace tubes had been demonstrated, an additional test was made by a commercial fabricator to determine if the diffusion heat treatment of a spray-aluminized pressure vessel could be given as a field stress-relief heat treatment. For this purpose, a 3/16-in. thick carbon-steel test vessel, approximately 30 in. in diameter and 5 ft long, was sprayed with 0.020 in. of aluminum. This coating was sealed with a hydrolyzed ethyl silicate solution, shot-peened, and subjected to a simulated field stress-relieving heat treatment. The outside of the vessel was insulated; the vessel was heated to 1300 F for 15 min by flue gases from a portable combustion unit, and then air-cooled. A sample was removed for metallographic examination. The vessel then was reheated to 1300 F for an additional 2 hours, it was air-cooled, and another sample was removed. During these heat treatments the oxygen content of the flue gases was kept below 2 percent.* Fig. 4 shows the structures of the coating after heating for 15 minutes and for 2 hours additional. The longer treatment increased the thickness of the alloy bond layer from 0.004 in. to 0.010 in. and decreased the thickness of the unalloyed residual aluminum coating from 0.013 in. to 0.006 in. **This test indicates the feasibility of using heat-diffused, sprayed aluminum coatings for protecting pressure vessels, provided the initial aluminum coating is deposited properly on a clean surface, the temperature of the diffusion heat treatment (and stress relief) is approximately 1300 F, and a protective atmosphere is maintained during the heat treatment.**

Further studies of aluminum coatings indicate that sprayed and heat-diffused aluminum coatings will have considerable stability in the usual operating temperature range of refinery equipment. Even when the coatings are overheated slightly above the melting point of aluminum, there is an excellent likelihood that the worst result will be a surface composed of a layer of aluminum-iron alloy.

If the aluminum coating is thick enough, a certain portion

*Attention is called to United States Patent No. 2,845,366, "Coating Articles with Metal," issued to Albert W. Schroeder on July 29, 1958.

may not become alloyed even with relatively severe temperature treatment. It appears that with such heavy coatings, a virtual limiting of the thickness of the alloy bond layer occurs and the remaining aluminum remains substantially unaffected. Fig. 5 shows that exposure to temperatures above 1300 F for at least 96 days did not cause any significant damage either to the outer aluminum layer or to the alloy bond layer.

Fatigue tests on aluminum-dipped specimens of carbon steel and AISI stainless steels Type 410 and Type 304 (along with blanks of undipped materials) indicated that **the presence of the iron-aluminum alloy layer reduced the fatigue strength** of the carbon steel and of the Type 410 steel **approximately 10 to 15 percent,** but it did not significantly affect the fatigue strength of the Type 304 steel.

Welding Problems on Aluminized Parts

There are some questions concerning the properties of welds made on aluminum-coated parts. To check the physical properties and soundness of welds of aluminized steels, a test butt weld was made between a 6-in. aluminum dipped elbow and an untreated, 6-in. aluminum-sprayed pipe. Both parent metals and the electrode were 2¼ percent chromium-1 percent molybdenum steels. On both parent metals, the aluminum coating extended to the edges of the machined surfaces. The weld was made in a horizontally fixed position with a 600-F preheat and was allowed to cool slowly, wrapped in asbestos, after welding. The weldment was held at 1300 F for 1 hour and furnace-cooled to stress-relieve the weldment and diffusion-bond the sprayed aluminum. The weldment then was gritblasted to remove the spatter. In tensile tests of a flat, reduced-section specimen the fracture occurred outside of the weld at a stress of 71-000 psi; the yield strength was 47,000 psi, and the elongation 27 percent in 2 in. A side bend test specimen bent 180 deg satisfactorily. Metallographic examination showed that for at least ½ in. on either side of the weld in both the aluminum-dipped and the aluminum-sprayed materials no free aluminum was present, although there was some slight amount of scattered aluminum-iron alloy in this area. It was not known whether this aluminum (and most of the aluminum-iron alloy) was lost during welding or during gritblasting, although the former was suspected. The weld metal was quite clean, and no inclusions were found which could be attributed to possible contamination by the aluminum coatings. A chemical analysis of metal cut from the root pass showed that it contained 0.13 percent of aluminum. This amount of aluminum probably would be ineffective in controlling corrosion by gases containing hydrogen sulfide.

In another test, two samples of carbon-steel piping which had been spray-aluminized internally and heat-diffused were welded together with 1¼ percent chromium-½ percent molybdenum electrodes by a fabricator who claimed that the technique employed caused sufficient aluminum to be retained in the root pass to afford it reasonable resistance to attack by gases containing hydrogen sulfide. One weld was made with the use of a silicone flux backup; after welding, the only internal area which did not have an aluminum coating was that of the first pass. The first pass of the other weld was made by the TIG (tungsten inert gas) process with the use of an argon purge. In this weld, some difficulty was reported in obtaining fusion to the aluminum coating. Both weldments were allowed to cool to room temperature and then were stress-relieved at 1325 to 1350 F for 1 hour. Metallographic examination of the two weld joints indicated that both were sound. Corrosion tests in a hydrogen sulfide-hydrogen atmosphere (concentration ratio: 7.5×10^{-3}) are being conducted to determine the relative rates of corrosion of the carbon steel, the root pass of the

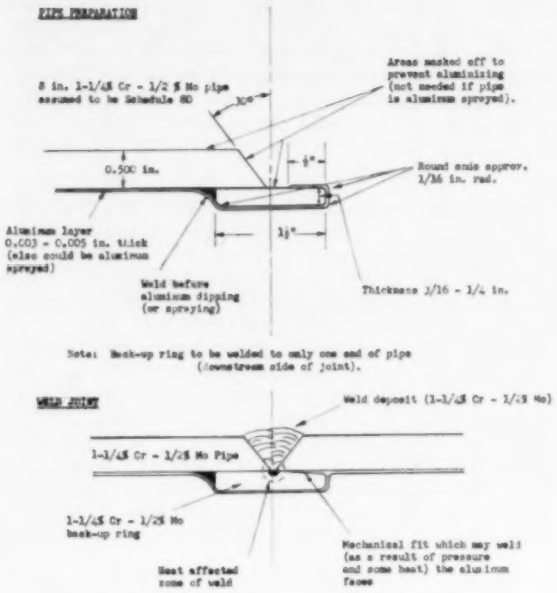

PIPE PREPARATION
6 in. 1-1/4% Cr - 1/2 % Mo pipe assumed to be Schedule 80
Areas masked off to prevent aluminizing (not needed if pipe is aluminum sprayed).
0.500 in.
Round ends approx. 1/16 in. rad.
Aluminum layer 0.003 - 0.005 in. thick (also could be aluminum sprayed)
Weld before aluminum dipping (or spraying)
Thickness 1/16 - 1/4 in.
Note: Back-up ring to be welded to only one end of pipe (downstream side of joint).
WELD JOINT
Weld deposit (1-1/4% Cr - 1/2% Mo)
1-1/4% Cr - 1/2% Mo Pipe
1-1/4% Cr - 1/2% Mo back-up ring
Mechanical fit which may weld (as a result of pressure and some heat) the aluminum faces
Heat affected zone of weld

FIG. 6. Means of welding aluminized pipe without losing the continuity of the aluminum coating or contaminating the weld metal with aluminum.

weld, and the crown of the weld. However, the fabricator states that the root pass may contain anywhere between 3 and 10 percent of aluminum. From published data,[5] this range of aluminum may be too broad. For example, even with 3 percent of aluminum, the resistance to hydrogen sulfide corrosion is the same as for unalloyed steel. It appears, therefore, that a minimum of 7 percent of aluminum would be required to offer reasonable corrosion resistance under these conditions.

One technique which was employed to good advantage in welding aluminum-dipped tubes for another reformer utilized a specially prepared backing ring which provided for a continuous aluminum coating across the weld and prevented the pickup of aluminum in the root pass. The details on the use of this backing ring are given in Fig. 6.

Acknowledgment

In the preparation of this paper, considerable information and assistance were supplied by the engineering staffs of the various Standard Oil Company (Indiana) refineries and by A. W. Schroeder of Chicago Metallizing Corporation; their help is gratefully acknowledged.

References

1. E. B. Backensto, R. D. Drew, and C. C. Stapleford, "High Temperature Hydrogen Sulfide Corrosion," *Corrosion* 12 [1] 22-32 (1956).
2. S. G. Sorell and W. B. Hoyt, "Collection and Correlation of High Temperature Hydrogen Sulfide Corrosion Data," NACE Technical Committee Reports (particularly references B-5 through B-9), *Corrosion* 12 [5] 213t-34t (1956).
3. T. Rosenqvist, "A Thermodynamic Study of the Iron, Cobalt and Nickel Sulphides," *J. Iron Steel Inst. (London)* 176 [1] 37-57 (1954).
4. A. Dravnieks and C. H. Samans, "Corrosion Control in Ultraforming," *Proc.* API 37 [III] 100-15 (1957).
5. F. K. Naumann, "Steels for Petrol-Producing Plants," *Tech Mitt. Krupp, Tech. Ber.* 6 77-87 (1938).

SERIES 60—normal needs, pressures to 400 psi, 6 sizes. **SERIES 120**—normal needs, pressures to 600 psi, 6 sizes. **SERIES 40**—for extra heavy loads, 5 sizes. **NO. 30**—for extra light loads (½" only). **INTEGRAL STRAINER**—highest pressures and marine use, 6 sizes.

NEW NO. 30 IS A LIGHT LOAD SPECIALIST

When the condensate load in your steam lines is *extra light*—this new Yarway ½" No. 30 Steam Trap is *exactly right*.

Specify it. You'll experience new *economy of operation* with the *tighter shut-off*. Operation is *quieter* due to lever action. *Maintenance is less*—because of the replaceable valve-seat assembly, only one moving part and stainless steel construction. Enjoy these special features plus all the regular advantages of famous Yarway Impulse Traps such as *quick heating, even temperatures, small size, good for all pressures, non-freezing.*

Over 1,250,000 Yarway Impulse Traps already sold; buy yours from one of 270 local Industrial Distributors.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY *impulse® steam traps*

24th MID-YEAR MEETING
DIVISION OF REFINING
NEW YORK

API Announces . . .

Refinery Instrumentation

A New Installation Guide

R. R. Proctor
The Pure Oil Company, Crystal Lake, Illinois

A NEW INSTRUMENT INSTALLATION MANUAL by the American Petroleum Institute will be published during late 1959 or early 1960. The manual is intended to serve as a guide for the installation of the generally used measuring and controlling instruments and related accessories to achieve safe, continuous, accurate, and efficient operation with minimum maintenance.

The manual entitled **"Installation of Refinery Instruments and Control Systems"** is the culmination of three an one-half year's work by the API Subcommittee on Instruments. Suggestion for the publication originated at the November 1953 subcommittee meeting but actual work on the manual was begun one year later.

The Subcommittee, which now represents 18 oil companies, developed the manual on the following assumptions — and herein lies the scope of the project and the proposed solutions to some of the problems which we all face:

1. The purpose of this manual should be to serve principally as a guide, or a compendium of recommended practices, for use by those who install or supervise the installation of the more generally used measuring and control instruments and related accessories in refineries in order to achieve safe, continuous, accurate, and efficient operation with minimum maintenance.

2. Many small refineries have inadequate or practically no instrument standards to assist their engineers and maintenance men in obtaining adequate installations.

3. Large companies could profit from such a manual by reducing the bulk of their instrument specifications and standards. The ready availability of such information in printed form also should be of considerable assistance in reducing the communications problems in placing easily understood standards for installation into the right hands at the various plants.

4. Contractors vary considerably in their recommendations and standards for installation of instruments in refineries; so much so that costs may vary as much as 300 percent for comparable services.

5. Instrument manufacturers could profit by such a manual if it were set up to assist in standardizing certain phases of installation. Many of these people have a real problem of visualizing the environment in which their products will be installed and used.

6. A suitable manual of installation practices could result in cost reductions on new installations as well as on modifications and revamps oftentimes not completely engineered.

7. Probably the most important advantage of such a manual would result when future jobs are considered involving much closer coordination of controls, faster response, higher reliability, and the actuation of more controls from a single location. The use of electrical instruments in transmission systems is rapidly expanding, together with more widespread use of automatic data recording, supervisory control by computers, and application of sampling and analytical instrumentation.

8. The proper installation of the presently available standard instruments should result in more satisfactory plant performance, lower per-barrel investments, and acceptable capital costs. The adoption of the newer and more completely coordinated controls, properly installed, should result in even better product control, greater reliability and safety, and reduced labor requirements.

When work was begun on the manual in November 1954, preparation of the text was assigned to individuals by sections: Flow, level, temperature, pressure, automatic controllers, control valves and positioners, transmission systems for measurement and control, seals, purges, and winterization, airsupply systems, hydraulic-pressure systems, electric-power systems, and instrument panels.

Although the information presented has been prepared primarily for petroleum refineries, much of it is applicable without change in chemical plants, gasoline plants, and similar installations.

It is the intent of the Subcommittee on Instruments to update the manual occasionally to keep it abreast of the newer developments in instrumentation.

"Users of this manual are reminded that publications of this type cannot be complete in the rapidly advancing field of instrumentation, and no written document can be substituted for qualified engineering analysis."

Despite this obvious limitation, it is the hope of the Subcommittee on Instruments that the manual will be accepted for what it is intended to be, i.e., a guide, and that when it is published — the scheduled date of which is as yet uncertain — the manual will prove useful to refiners, and to both engineering and maintenance personnel. ★ ★ ★

Adapted from paper presented to a session on instruments during the 24th Midyear meeting of the American Petroleum Institute's Division of Refining in New York, N. Y., May, 1959. Permission of API to publish this paper is gratefully acknowledged.

PROCESSING

24th MID-YEAR MEETING
DIVISION OF REFINING
NEW YORK

Reduced Maintenance and Longer Runs Result When . . .

Processing Crude Oil at Low pH

Resulting Reduction of Ammonia Contamination Offers . . .

1. *Improved Reformer Charge Stock Quality*

2. *Lowered Costs of Chemical Treating of Distillates*

3. *Minimized Diesel Fuel Corrosive Agents*

J. A. Biehl • **E. A. Schnake**
The Ohio Oil Company, Robinson, Illinois

THE OHIO OIL COMPANY'S REFINERY, located at Robinson, Illinois, experienced considerable difficulty with corrosion and product contamination when operating the crude-oil unit at high pH on overhead receiver waters by use of ammonia injection. Approximately 5 years ago, the pH control was lowered to a 4.0 to 4.5 range and inhibitor use was increased. This change has resulted in excellent control of corrosion, product quality improvement, and several other benefits. The following discussion summarizes the refinery operation for the past 5 years at the low pH control of overhead receiver waters.

Adapted from paper presented by E. A. Schnake to a session on processes during the 24th Midyear meeting of the American Petroleum Institute's Division of Refining, New York, May 1959. Permission of the API Division of Refining to publish this paper is gratefully acknowledged.

Crude Handled

The crude oil processed during the 5-year period of low pH on overhead receiver waters had an average API gravity of 36 deg, a sulfur content of 0.23 percent, and an average salt content of 30 lb per 1000 bbl expressed as sodium chloride. During this period, the refinery has had limited runs of higher sulfur crude oil.

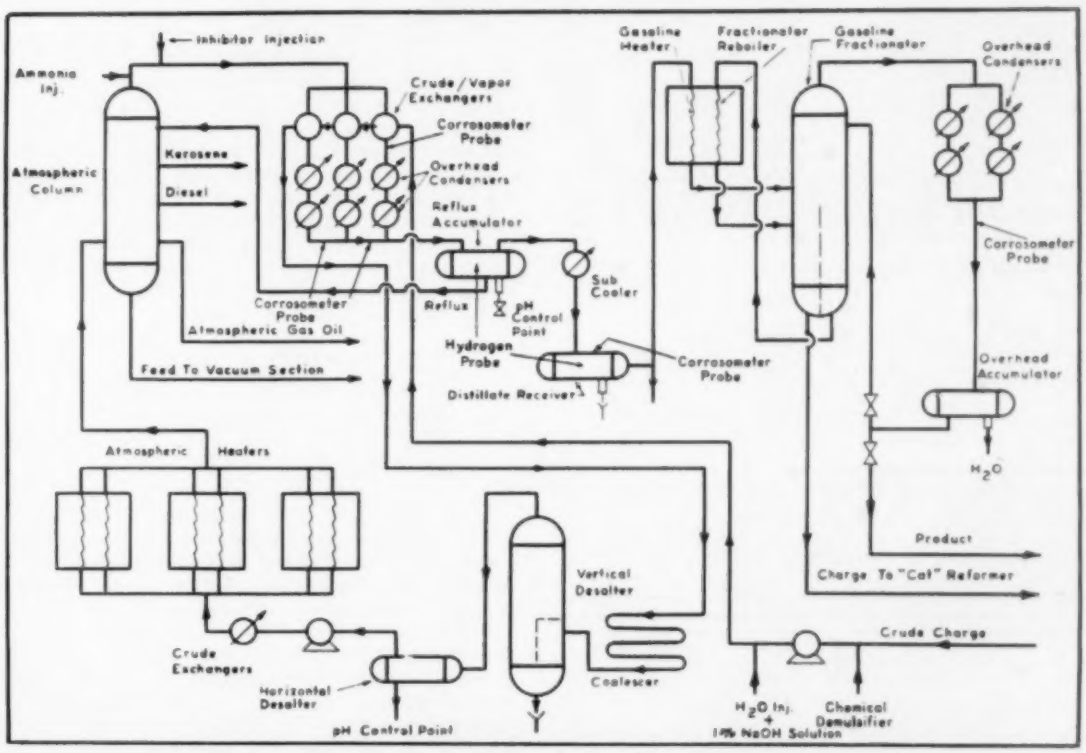


FIG. 1. Crude-oil unit simplified flow diagram of desalting, atmospheric, and gasoline fractionation sections.

Desalting. Before processing, the crude oil is desalted in a chemical desalting unit. A demulsifying agent is injected into the raw crude-oil stream ahead of the crude-oil pump suction. A 5 percent by volume of water and a 1 percent solution of sodium hydroxide are also injected into the crude oil ahead of the desalters. A pH of approximately 8.0 is maintained on the water effluent from the horizontal desalter vessel by regulating the caustic injection. The desalter effluent water enters the refinery sewer system. The desalted crude-oil charge to the unit averages approximately 1.23 lb of salt per 1000 bbl. The efficiency of the desalting process averages 95 percent. A general simplified flow of the desalting, atmospheric, and gasoline fractionating sections is shown in Fig. 1. A rather complete description of unit flow and construction materials was given in a previous paper.[1]

Unit materials. All crude-oil unit overhead equipment, operating at low pH on overhead receiver waters, is constructed of the conventional materials, carbon steel and admiralty. All overhead piping, exchanger and condenser shells, heat exchanger tube bundles, and overhead receivers are constructed of carbon steel; however, overhead condenser bundles are constructed of inhibited admiralty.

pH Control. The pH was controlled by neutralization of the hydrogen chloride by ammonia injection to a pH of 4.0 to 4.5. An amine-type corrosion inhibitor was injected at a rate of 10 ppm to 15 ppm to provide protection against corrosion attack by hydrogen sulfide and other weak acids. Since operating at low pH, turnaround inspections have been scheduled at 18-month intervals. These inspections have indicated that all equipment was in excellent condition and nothing has had to be replaced as a result of corrosion in the overhead system.

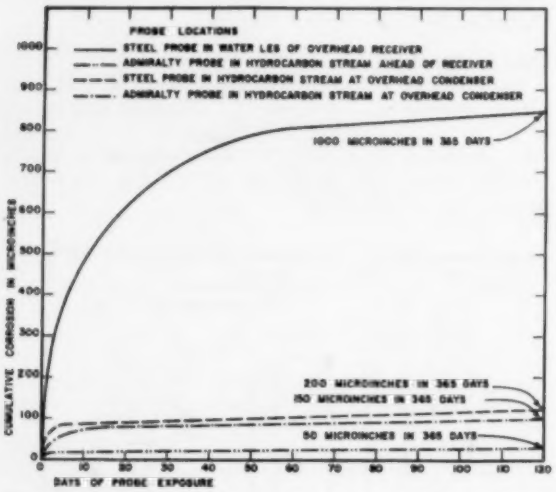

PROBE LOCATIONS
STEEL PROBE IN WATER LEG OF OVERHEAD RECEIVER
ADMIRALTY PROBE IN HYDROCARBON STREAM AHEAD OF RECEIVER
STEEL PROBE IN HYDROCARBON STREAM AT OVERHEAD CONDENSER
ADMIRALTY PROBE IN HYDROCARBON STREAM AT OVERHEAD CONDENSER
1000 MICROINCHES IN 365 DAYS
200 MICROINCHES IN 365 DAYS
150 MICROINCHES IN 365 DAYS
50 MICROINCHES IN 365 DAYS
CUMULATIVE CORROSION IN MICROINCHES
DAYS OF PROBE EXPOSURE

FIG. 2. Cumulative corrosion monitoring by electrical resistivity probes.

Corrosion Rates At Crude Unit Atmospheric & Gasoline Overhead Equipment		
12 Months of operation at pH of 6.8–7.5 with NH_3 injection only.	12 Months of operation at pH of 6.8–7.5 with NH_3 + 6ppm of organic amine inhibitor injection.	5 Years of operation at low pH of 4.0 – 4.5 with small amount of ammonia injection + amine inhibitor injection rate at 9–12ppm.
Carbon Steel		
General Rate 0.04 ipy Pitting Depth 0.07 ipy Heavy scale on equipment plus heavy sludge deposits.	General Rate 0.01 ipy Pitting Depth 0.03 ipy Light scale on equipment plus light sludge deposits.	General Rate 0.001–0.004 ipy Very Mild General Pitting. Very light scale or film.
Inhibited Admiralty		
Severe pitting at condenser inlet only and general heavy attack under sludge deposits at rate of 0.06 ipy. Stress Cracking	Severe pitting at condenser inlet at rate of 0.05 ipy. Moderate attack under sludge at rate of 0.025 ipy. No Cracking	Very mild general overall attack less than 0.002 ipy. No Cracking

FIG. 3. Revised corrosion rates at crude-oil unit atmospheric and gasoline overhead equipment.

Monitoring corrosion. From the start of low pH operation, corrosion rates were closely checked by means of removable test coupons, hydrogen probes, and analyses of overhead waters for iron and copper content. All of these methods indicated satisfactory protection of equipment once a protective film was established on clean surfaces. The removable metal test coupons showed the initial rate of corrosion attack on clean metal surfaces to be high but once a protective film was established corrosion rates were well within acceptable limits. To develop definite corrosion data, it was desirable to establish the length of time required to form the protective film on both admiralty and steel at different locations under operating conditions. A practical method for monitoring the initial rates appeared possible by utilizing electrical-resistance-type corrosive probes. This method consists basically of exposing the metal to be tested in a stream and making it a part of an electrical circuit. Any corrosion of the metal coupon decreases the cross-section area and changes the resistivity. The fundamentals have been discussed by other authors.[2]

Electrical-resistance-type corrosion probes of both steel and admiralty were installed at various locations in the crude-oil overhead system as indicated in Fig. 1. In order to obtain a true picture of corrosion throughout the system, probes were installed from the point condensation of the stream starts down to and including the water leg of a receiver. The graph, Fig. 2, shows the cumulative corrosion in microinches (millionth of an inch) plotted against service time of probes. The graph clearly indicates the initial rate of attack and the time required for a protective film to be established at the low pH conditions. All probes in the hydrocarbon stream indicated a moderate attack the first few days but stabilized after about 10 days of exposure. The steel probe, located high in the overhead system, showed a cumulative corrosion of 50 μin. the first 24 hours which represented a rate of attack of 0.018 in. per year. The cumulative corrosion for a period of a year, however, was only 200 μin., or 0.0002 in. per year or practically negligible. All admiralty probes indicated very low attack. The steel probe in the water leg of the receiver indicated the highest initial rate of corrosion and approximately 60 days of exposure was required for a good protective film to be established; however, the corrosion rate over a period of a year was low and well within acceptable limits as shown in the following tabulation:

Cumulative Corrosion of Steel Sample in Water Leg (Microinches)	Corrosion Rate (Inches per Year)
180 in 1 day	0.07
700 in 30 days	0.008
830 in 60 days	0.004
1000 in 365 days	0.001

From the results obtained, it appears that electrical-resistance-type corrosion probes are a valuable tool in corrosion monitoring because corrosion rates of operating refinery equipment can be obtained quickly as compared to the time required by other methods.

From the excellent condition of equipment on turnaround inspections and the results obtained by the use of electrical-resistance-type corrosion probes, the corrosion rates at low pH operations have been revised downward from the rates originally published.[1] The revised rates of low pH operation with inhibitor injection rates of 9 ppm to 12 ppm — as compared to the corrosion rates when

Low cost

KOCH FLEXITRAYS

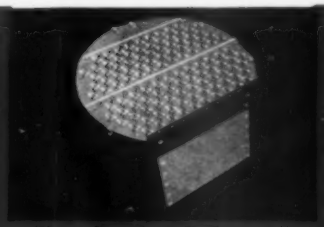
Increase Fractionating Efficiencies in Vickers' new Udex* Extraction Unit

Vickers' new multi-million dollar petrochemical complex built by Procon, Incorporated, is the first petrochemical plant to be built in Kansas, and is expected to produce more than 15 million gallons of petroleum aromatics annually.

Throughout the world, operators have proved that Koch's economical fractionating trays have as much as 25% better efficiency than conventional bell cap trays... give higher capacities, lower pressure drop, and reduce maintenance costs. Over 950 installations have proved the Koch Flexitray's superiority over other devices in capacity, flexibility, and efficiency! KOCH FLEXITRAY—COPIED BY OTHERS—MATCHED BY NONE!

In planning your next tower, consult KOCH!

*Registered Trademark of Universal Oil Products Company



KOCH

ENGINEERING COMPANY, INC.

321 West Douglas Avenue, Wichita 2, Kans.

More than 30 years of tray process design

REPRESENTATIVES

BOISE, IDAHO
C. W. Wallace & Co., P. O. Box 719

DENVER, COLORADO
C. W. Wallace & Co., 324 Denham Bldg.

EL PASO, TEXAS
C. W. Wallace & Co., Mills Bldg.

HOUSTON, TEXAS
Alpha Engineering Co., P. O. Box 12251

KANSAS CITY 12, MISSOURI
Douglas Smithers, P. O. Box 7051

NEW YORK 17, NEW YORK
F. J. Macdonald Co., 60 East 42nd Street

OAKLAND, CALIFORNIA
Engineered Process Equip. Co., 900 Fifteenth St.

PARK RIDGE, ILLINOIS
H. S. Fisher, 1921 Courtland Ave.

PASADENA, CALIFORNIA
Engineered Process Equip. Co., 774 East Green St.

PITTSBURGH 19, PENNSYLVANIA
D. B. Foster Company, 2216 Koppers Bldg.

SALT LAKE CITY, UTAH
C. W. Wallace & Co., Continental Bank Bldg.

SOUTH CHARLESTON, WEST VIRGINIA
D. B. Foster Co., 411 "D" St.

ST. LOUIS 17, MISSOURI
Douglas Smithers, 2030 Dg Bank Bldg.

TULSA, OKLAHOMA
Ryans-Doherty Co., P. O. Box 1410

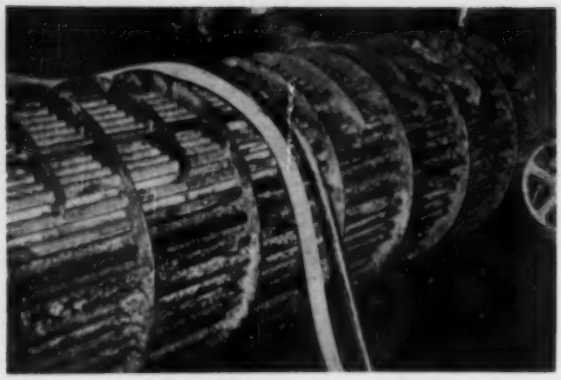


FIG. 4. Scale and sludge deposits on atmospheric overhead condenser bundle at high pH operation.

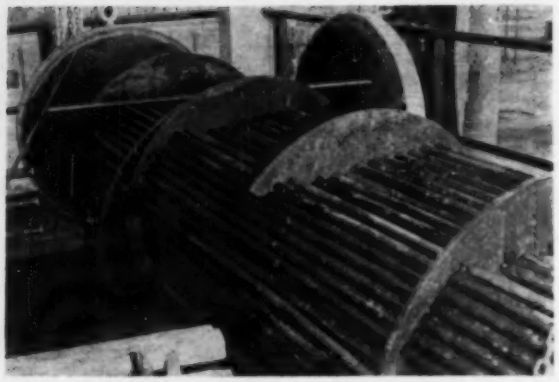


FIG. 5. Clean conditions of atmospheric overhead condenser bundle after low pH operation.

operating at: (1) high pH and ammonia, and, (2) high pH and ammonia plus inhibitor — are shown in Fig. 3.

Cleanliness of Equipment

At high pH operation, fouling of overhead equipment with heavy sludge deposits ahead of exchanger baffles and in areas of low flow rates was a serious problem. This resulted in shorter runs at decreased capacities because of inefficient heat or cooling transfer surfaces; also increased corrosion occurred under the sludge deposits. Fig. 4 illustrates heavy scale and sludge deposits on an atmospheric overhead condenser bundle as removed after 9 months' service at high pH. At low pH, equipment remains clean and free of objectionable salt and sludge deposits. Cleanliness of operating heat exchange and condensing equipment permits longer runs between scheduled shutdowns at increased capacities. Fig. 5 shows a clean bundle after 18 months' service at low pH operations. The inhibitor film on an overhead exchanger shell after low pH operation is shown in Fig. 6.

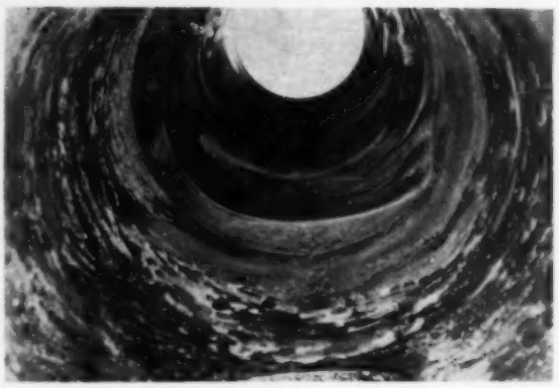


FIG. 6. Inhibitor film on overhead exchanger shell after low pH operation.

Crude-Oil Unit Hydrogen Ion Activity

During the past few years, the crude-oil unit has experienced periods of hydrogen ion activity in the distillate receiver. This activity was indicated by a hydrogen probe installed at the oil-water interface. Since this activity was intermittent and relatively low, no serious problems existed; however, it was desired to determine the cause of this condition.

Earlier study of this condition indicated that arsine might be a contributor to hydrogen ion activity.[1] It was believed arsine would form in the fractionation section of the crude-oil unit inasmuch as the crude-oil charge contained considerable arsenic. Since a slight reducing condition exists in most crude-oil units, the presence of arsine is very probable. It was believed the arsine gas would pass overhead into the distillate receiver and result in arsenic plating and formation of atomic hydrogen. This atomic hydrogen would therefore cause hydrogen probe activity.

Although it is practically impossible to obtain samples to confirm the presence of arsine, a program was outlined to obtain samples of the receiver water prior to and after hydrogen activity for total arsenic determinations. The values obtained were plotted against the hydrogen probe activity and the result is shown in Fig. 7.

It is interesting to note from this graph, that hydrogen ion activity occurs following a surge of high arsenic levels. This condition follows approximately 36 to 48 hours after the existence of high arsenic content and the activity remains for approximately the same length of time as this high arsenic level exists. This pattern was repeated several times so it is fairly evident arsenic has a definite role in hydrogen ion activity.

Arsenic contents of the many Illinois Basin crude oils were determined and found to vary considerably. This accounts for the occasional high arsenic surges noted in the overhead receiver water. Although the condition has not been serious, it might be in the future should high arsenic crude oils be refined with regularity. Studies have been and are being made to combat this problem:

1. Investigation of **arsenic removal** from crude oil by operational changes in desalting. These changes are primarily oil-water ratios, improved mixing, temperature variance, and control of pH of the desalter water. It has been reported that oil-water ratios and mixing have a definite bearing on efficiency of arsenic removal by desalting operations.
2. Investigation of **inhibitor protection** against arsine attack. If an inhibitor provides a complete and stable film on the equipment, the release of atomic hydrogen by deposition of arsenic from arsine will be minimized.
3. Introduction of **small quantities of air** into the crude-oil fractionation system **to provide a slight oxidizing condition.** This would minimize the formation of arsine in this section and control the hydrogen ion activity in the receiver section from this constituent.

The third method probably accounts for the protection from arsine attack in the catalytic cracking unit as the receiver waters from this process are rich in arsenic. The trapped oxygen in the regenerated catalyst, along with steam injection, provides an oxidizing atmosphere and eliminates the possibility of arsine generation. This oxidizing action seems probable because of the formation of phenols and polysulfides.

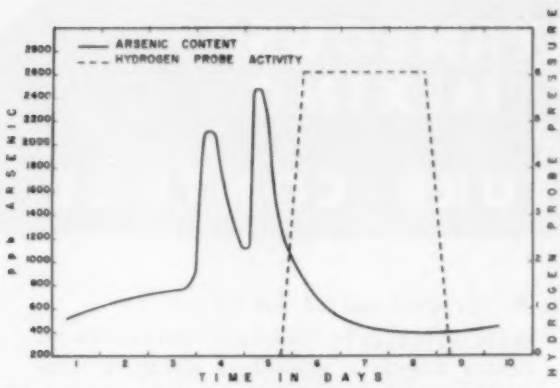


FIG. 7. Hydrogen probe activity following high surges of Arsenic.

Effect of Ammonia on Processing and Product Quality

The presence of ammonia and ammonium salts in the hydrocarbon streams from crude-oil distillation have definite effects on several refinery processes and also on the quality of products. Operation of crude-oil units at low pH on overhead receiver waters minimizes the quantity of ammonia and its salts present in these streams. The formation of ammonia from the organic nitrogen compounds in process charge stocks will continue as this is an internal source which cannot be controlled unless the stock is subjected to a chemical treatment. A discussion on the effect of ammonia in refinery operations points out the need for controlled quantities entering either from external or internal sources into the hydrocarbon streams.

Catalytic Reformer Pretreater

Prior to the low pH operation of the crude-oil unit, considerable fouling occurred in the heat exchangers of the catalytic reformer pretreatment section (Fig. 8). Analysis of the fouling material showed the presence of ammonium salts. The fouling was also attributed to the oxidizable sulfur compounds and dissolved oxygen.[8] Shortly after this trouble, the pH was lowered on the crude-oil unit receiver water and the oxygen in the catalytic reformer feed reduced by gas blanketing of charge tanks. These changes eliminated the fouling difficulties. When charging material to the reformer which contains basic organic nitrogen compounds, ammonia is formed in the guard case section. The majority of the ammonia passes overhead in the prefractionator tower and deposits in the gas lines resulting in restricted flows. A portion of the ammonia remains in the reactor charge stock and enters the reactors and there disturbs the catalyst activity by reduction of acidity. To counteract this condition, it is necessary to add chlorides continuously to maintain the desired catalyst acidity for greatest efficiency and longer life. These basic organic nitrogen compounds can be removed from the reformer charge by acid treatment, thus eliminating the deleterious effect of ammonia. By operating at low pH on the crude-oil unit, the external source of ammonia in the reformer stock is kept at a minimum.

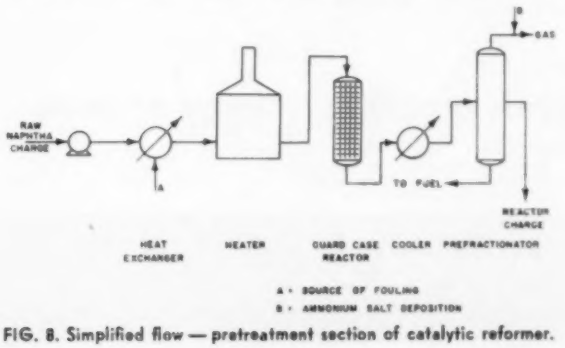


FIG. 8. Simplified flow — pretreatment section of catalytic reformer.

At Robinson, Illinois, the light straight-run gasoline and kerosine streams are treated by the Linde Copper process and the presence of ammonia in these two streams has a marked effect upon the treatment. When operating at high pH levels at the crude-oil unit, ammonia is entrained in the streams and passes through the caustic hydrogen sulfide scrubbers and enters the treating process. At this point, the ammonia will react with the liberated hydrogen chloride from the mercaptan conversion to disulfides and thus prevent the regeneration of cuprous chloride to cupric chloride. The cuprous chloride, being soluble in the hydrocarbon streams, will be removed from the slurry tower and attack the product lines, particularly at bend areas (Fig. 9). This results in deposition of metallic copper and the formation of iron chlorides. Continued corrosion attack resulted in several line failures. The iron chloride dissolves in the hydrocarbon streams and results in product discoloration, particularly on kerosine. With the crude-oil unit operation at the low pH value, the ammonia in these two streams is minimized and the treating program has operated smoothly. The change to lower pH has improved the treating process as follows:

a. Treating chemical savings.
b. Reduction of corrosion.
c. Improved color of treated products.
d. Lower metal deactivator requirements.

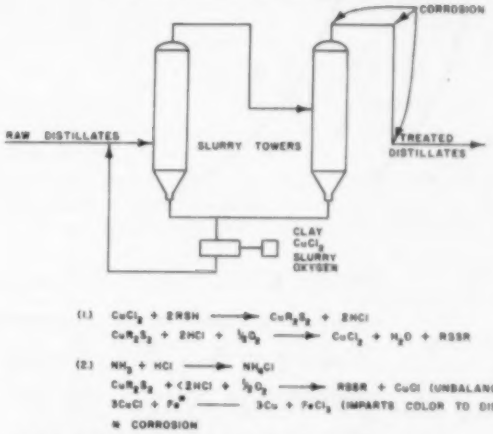

CORROSION
RAW DISTILLATES
SLURRY TOWERS
TREATED DISTILLATES
CLAY
SLURRY
OXYGEN
(1) CuCl2 + 2RSH → CuR2S2 + 2HCl
CuR2S2 + 2HCl + ½O2 → CuCl2 + H2O + RSSR
(2) NH3 + HCl → NH4Cl
CuR2S2 + (2HCl + ½O2 → RSSR + CuCl (UNBALANCED)
3CuCl + Fe → 3Cu + FeCl3 (IMPARTS COLOR TO DISTILLATES)
= CORROSION

FIG. 9. Simplified flow — distillate treating process.

Diesel Fuel Problem

Prior to the low pH operation, frequent trouble with ammonia in diesel fuel was encountered. The ammonia in this product caused failure of sintered copper filters in large diesel installation, as well as deterioration of copper fuel lines. The ammonia and ammonium salts caused increased corrosion of diesel storage tanks. The excess ammonia accelerated dissociation of the ammonium salts liberating gaseous ammonia and forming of mineral acids. The ammonia migrated to the hydrocarbon phase and the acids concentrate in the aqueous phase. As these acids formed, the tank bottoms were attacked, resulting in accelerated corrosion (Fig. 10). With the reduction of ammonia injection into the crude-oil unit, contamination of the diesel stream by this constituent was reduced. Complaints from customers were minimized and storage-tank corrosion has been retarded.

Cracking Units

Although no specific effect was observed with ammonia and its salts in gas-oil charge stock to cracking units, it is a

FOR SIMULTANEOUS INTENSIVE MIXING *and* CLOSE TEMPERATURE CONTROL

★**A dominant factor in alkylation** through production of better alkylate with less catalyst consumption and other economies.

★**Widely used in grease making** to produce a more uniform soap with shorter time cycles and reduced manpower requirements.

★**A leader** in new fields of continuous sulfonation, lube oil treating and for other contacting purposes.

★**The answer** to many "unsolvable" petrochemical and chemical problems requiring close temperature control in the reactor.

Stratco Contactors may be designed for almost any degree of mixing short of homogenization. With internal heat transfer surface they provide extremely close control of temperature throughout the entire liquid volume of the contactor. The reacting liquids are maintained in the desired degree of dispersion throughout their residence time, and residence time may be varied to suit the problem. Stratco Contactors are available in sizes from 300 cc volume laboratory units up to 11000 gallon volume or larger commercial sizes.

● ***They are adaptable to your process problems... large or small***

REPRESENTATIVES

D. D. Foster Co., Pittsburgh
D. D. Foster Co., S. Charleston, W. Va.
Lester Oberholtz, Los Angeles
Rawson-Houlihan Co., Inc., Houston
The Rawson Co., Inc., Baton Rouge
F. J. McConnell Co., New York

STRATFORD ENGINEERING Corporation

PETROLEUM REFINING ENGINEERS

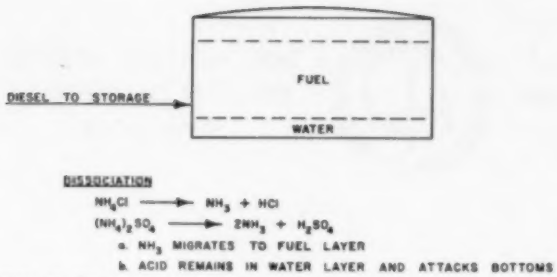


FIG. 10. Diesel storage diagram.

proved fact that nitrogen compounds adversely affect the activity of fluid catalysts. At some critical temperature, hydrocarbons will react with ammonia to form hydrogen cyanide (Fig. 11). The hydrogen cyanide effect on equipment has been reported by other authors, particularly with regard to hydrogen blistering.[4] The Robinson refinery experienced an accelerated formation of hydrogen cyanide gas when operating at high throughputs and reactor temperature over 905 F. The higher throughput provided more entrained oxygen in the catalyst from the regeneration section.

H_2SO_4 Alkylation

As in the catalytic cracking operation, no noticeable effect was observed in the sulfuric acid alkylation process when the change was made from high to low pH range at the crude-oil unit. Any ammonia present in the charge comes from an internal source (cracking operations) or as ammonium sulfate present in the purchased sulfuric acid. The unit has had failure of admiralty tubes in the deisobutanizer overhead condenser as the result of ammonia (Fig. 12). The ammonia entering the unit with the charge is removed in the reactor section by the formation of ammonium sulfate which is soluble in the acid; however, a quantity of acid is carried by the reactor effluent which is subjected to caustic scrubbing. When the acid in the reactor effluent is neutralized by caustic scrubbing, the dissolved ammonium sulfate also reacts with the caustic resulting in the formation of sodium sulfate and the liberation of ammonia gas. The water wash, following caustic scrubbing, does not completely remove the liberated ammonia inasmuch as the pH is relatively high as a result of caustic carryover. The ammonia, therefore, enters the deisobutanizer tower and passes overhead into the condenser to promote stress cracking of the admiralty tubes. It has been determined that the majority of this ammonia for this attack originates from the ammonium sulfate in the fresh acid make-up to the unit, especially if the acid is reclaimed.

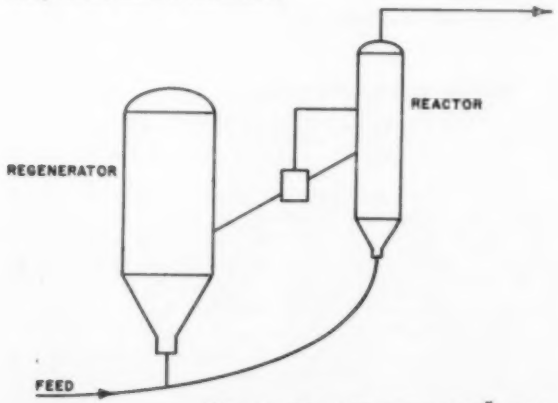


FIG. 11. Simplified catalyst flow section of FCC unit.

Delayed Coker

Lowering of the pH on the crude-oil unit overhead receiver waters did not have appreciable effect upon the operation of the delayed coker. Considerable trouble was experienced since the unit start-up with fouling of furnace tubes. This necessitated frequent shutdowns for furnace-cleaning operations. Analysis of the coker charge, which is vacuum residuum, during this period of fouling showed an alkalinity content as sodium hydroxide of 20 lb to 30 lb per 1000 bbl. At this time, the desalter operation was carrying a pH of 8.5 to 9.0 on the water outlet. By lowering this pH to 8.0 to 8.2, the alkalinity content of the coker charge was decreased to 1 lb to 2 lb per 1000 bbl as sodium hydroxide. This decrease has practically eliminated the fouling problem. Desalting operations have improved in that emulsion problems are at a minimum and the extraction efficiency at a maximum.

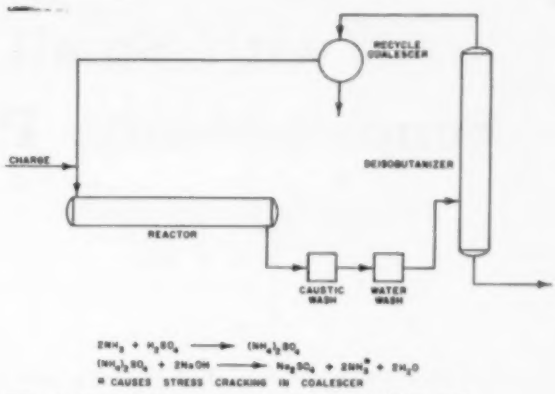


FIG. 12. Simplified flow — reactor section alkylation unit.

Conclusion

As a result of 5 years of operation at reduced pH level on crude-oil unit overhead receiver waters, together with increased inhibitor injection rates, these conclusions appear evident:

1. The lower pH minimizes the ammonium-salt dissociation which contributes to complex corrosion problems and formation of iron and copper sulfides.
2. The equipment is clean and free of sludge deposits which greatly reduces maintenance costs at scheduled turnarounds.
3. Clean equipment and excellent corrosion control has resulted in longer runs even at increased charge rates.
4. If the hydrogen chloride is neutralized with ammonia to a pH of 4.0 to 4.5, inhibitors will provide a simple and effective surface film for protection of equipment from attack by hydrogen sulfide and other weak acids.
5. When ammonia is injected only for chloride neutralization, ammonia and ammonium salt contamination of all hydrocarbon streams are kept at a minimum, resulting in improved processing operations and product quality.
6. The major portion of the hydrogen sulfide is retained in the hydrocarbon streams at the low pH level which assists in obtaining cleaner waters in the pollution abatement program.[5]

References

1. J. A. Biehl and E. A. Schnake, "Corrosion in Crude-Oil Processing—Low pH vs High pH," *Proc. API* 37 [III] 129-34 (1957).
2. Andrew Dravnieks and Horace A. Cataldi, "Industrial Applications of a Method for Measuring Small Amounts of Corrosion without Removal of Corrosion Products," *Corrosion* 10 [7] 224-30 (1954).
3. W. T. Maddock and J. A. Biehl, "The Case of the Fouled Feed Preparation Unit," *Petrol. Processing* 98-101, Nov. (1956).
4. R. T. Effinger, M. L. Renquist, A. Wachter, and J. G. Wilson, "Hydrogen Attack of Steel in Refinery Equipment," *Proc. API* 31M [III] 128-29 (1951).
5. J. J. Hur, "Topic of the Month: 'Organic Inhibitors Improve Ammonia Control, Reduce Sulfide in Refinery Waste Waters'," *Corrosion* 10 [2] 1 (1954).

★ ★ ★

24th MID-YEAR MEETING
DIVISION OF REFINING
NEW YORK

Unattended operation reduces costs when . . .

Guiding Refinery Operations with Small Semiautomatic Pilot Plants

W. M. Miller
Tidewater Oil Company, Associated, California

PILOT-PLANT DATA provide a valuable source of useful and reliable information for planning and controlling refinery operations at the Avon and Delaware refineries of the Tidewater Oil Company. By comparison, run data taken from refinery unit log books may often be inaccurate or of dubious value for the following reasons:

a. The composition of the charge to crude-oil units often is not accurately known, because of storage limitations and other reasons.

b. Intermediate streams, such as gas oils and naphthas, become comingled in an extremely complex manner in the refinery and make it virtually impossible to determine the composition of the charge to downstream processing units.

c. The complex interrelationships between the various processing units result in operating changes at one unit affecting the operation of other units down the line. This means that static operating condition on a unit for any prolonged period of time are rare.

d. Accurate yield data are next to impossible to obtain from those units which are tied in with gas plants serving several units.

e. Temperature, pressure, and flow recording instruments at the refinery units usually have greater calibration errors than do laboratory meters, so that operating conditions and flow rates are not known precisely. In many cases, some of the streams are not even provided with meters, making it necessary to obtain the volume of these streams by difference.

These variables and many others are avoided in pilot-plant operations, making it possible to obtain accurate yields and product properties from individual feedstocks or mixtures of known origin.

Adapted from paper presented to a session on processes during the 24th Midyear meeting of the American Petroleum Institute's Division of Refining, New York, May 1959. Permission of the API Division of Refining to publish this paper is gratefully acknowledged.

Pilot-Plant Data

Pilot-plant data provide the basis for guiding many of the Avon and Delaware refinery operations. Chief among them are:

1. **Planning and forecasting refinery operations.**
2. **Long and short-range economic studies.**
3. **Checking guarantee yields on new refinery installations.**
4. **Determining causes for unsatisfactory yields in commercial units.**
5. **Determining optimum operating conditions.**
6. **Recommending changes in operating procedures.**
7. **Selecting new processes.**
8. **Sizing new refinery equipment and modifying old equipment.**
9. **Special investigations.**

1. Planning Refinery Operations

A. REFINERY PRODUCTION FORECASTS AND BUDGETS

Starting with the crude-oil input data and the use of crude-oil analyses together with pilot-plant yields of products from catalytic cracking, fluid coking, hydrodesulfurizing and catalytic reforming, along with test-run data on other units within the refinery, a forecast can be made of the volumes of all products to be manufactured at the refinery. In addition, much information concerning the quality characteristics of these products is accurately determined in advance. For example: Volatility, vapor pressure, and octanes of premium and regular grades of motor gasoline, as well as the sulfur content of diesel and residual fuel oils, and certain other properties of products which have to meet specifications are forecasted. In a refinery such as Avon in

A Stearns-Roger produced plant, large or small, has the finished, workman-like appearance that says "here is another quality installation."

Enduring quality . . . .

For the utmost in design — engineering — fabrication — field erection — turnkey operation — take it up with . . .

Stearns-Roger

THE STEARNS-ROGER MFG. CO. • DENVER, COLORADO

DENVER • HOUSTON
EL PASO • SALT LAKE CITY
Stearns-Roger Engineering Co., Ltd., Calgary

which a great many different types of crude oils are processed throughout the year, and the charge is always a blend of several crude oils, an accurate refinery production forecast without pilot-plant data on the individual crude oils could not be made. Even with this information, the problem is extremely complex because of the large number of units and the interdependence of one unit upon another.

To make an accurate forecast by processing a mixture of several crude oils through the various refinery units, on paper, requires a number of man-days and countless mathematical calculations. To reduce the time element and the amount of work, these production forecasts and budgets are now done on an IBM 650 machine. The electronic data computer programs used in this work include mathematical models of the various units within the Avon and Delaware refineries and can be made to simulate different types of refinery operations by changing the instructions and input data to the individual models within the program. These mathematical models were constructed from pilot-plant data and the effect of various operating variables on yields and product properties as determined from pilot-plant runs.

It has been found that the use of pilot-plant data in the refinery simulation program gives more reliable results than attempting a correlation of yields from average feedstock properties. Fortunately, considerable data had been accumulated in the Avon pilot plants prior to developing the computer program. In the case of catalytic cracking, data is available on virgin gas oils from more than 45 different crude oils. As new pilot-plant data become available, the IBM 650 program can be easily revised without disturbing its sequence.

In setting up the computer program for processing mixtures of several different feedstocks through a unit, it was assumed that each feedstock would react (crack in the case of catalytic cracking) in a mixture as if it were being reacted by itself at the same severity of operation selected for the mixture. To prove the validity of this assumption, a study was made in our catalytic cracking pilot plant on several feedstocks and a known mixture of the same stocks in which all the operating variables were held constant except for the weight hourly space velocity. From these tests it was observed that at a given weight hourly space velocity (severity), each of the stocks cracked at different conversions. However, when the yields at these different conversions on the individual stocks were added together in their proper proportions, the combined yields were in close agreement with those obtained on the mixture.

B. SELECTION OF CRUDE OILS

The selection of crude oils for a refinery depends on a number of factors, of which the cost, yields, and properties of the products produced are of vital importance. The oil purchase and exchange department of our company relies on results from the refinery simulation program for estimates of the margin of profit from individual crude oils in making decisions on which crude oil to buy or exchange. Without crude-oil analysis and pilot-plant yields, a margin estimate would be no better than a guess.

2. Long and Short-range Economic Studies

Pilot-plant data have been invaluable in making economic studies for long-range projects such as refinery expansion to meet increases in forecasted sales volumes, modernization of old equipment, and installation of new equipment to upgrade marginal products and meet changing product specifications.

Short-range economic studies, such as utilizing idle unit capacity for processing oil for other companies, increasing the capacity of existing units by the use of untried processing ideas, and reducing chemical usage through installation of new equipment, have been based on pilot-plant data.

3. Checking Guaranteed Yields on New Refinery Installations

The licensor of a new process unit at Avon recently used the results from one of the Avon pilot plants to determine whether the new commercial unit met its yield guarantee.

4. Determining Causes for Unsatisfactory Yields in Commercial Units

There have been a number of cases in which our pilot plants have been used to determine the cause of unsatisfactory commercial yields. In one of these cases it was found that the gasoline yield was lower after the turnaround of a catalytic cracking plant than before shutting down the unit. Pilot-plant tests revealed that a change in quality of the feed was responsible for the lower yields and that nothing was physically wrong with the unit or the catalyst.

5. Determining Optimum Operating Conditions

A pilot-plant study was undertaken to determine what cut point should be used at the feed-preparation vacuum stills to produce the greatest total value of net products from catalytic cracking plus fluid coking. This work not only determined the optimum cut point but also the break-even cut point for starting up a second feed-preparation still when the metals content of the virgin gas oil limited the throughput of the first unit.

6. Recommending Changes in Operating Procedures

Tests were made in our catalytic reforming pilot plant on samples of catalyst taken from each reactor at the end of a commercial reformer run. From this work it was recommended that in the future the process department maintain the first reactor at maximum severity and operate the third reactor at a lower severity throughout the run. This practice has now been accepted in the refinery. Another example was a fluid coking pilot plant run on catalytic decanted gas oil. This was being run in the commercial fluid coker to improve its catalytic cracking characteristics. The pilot plant tests disclosed that fluid coking reduced the carbon residue but did not improve the catalytic cracking yields from this stock. On the basis of this and the insignificant amount of cracking that occurred to it during fluid coking, it was recommended to eliminate the fluid coking of this stream. It would have been extremely difficult and expensive to determine this in commercial units.

7. Selecting New Processes

Pilot plants usually are not used at Avon to develop new processes. However, in some cases these small pilot plants have been used to evaluate existing new processes. Examples of this are the selection of the new fluid coking process and the selection of mild reforming plus solvent extraction.

DU PONT *Petroleum Chemicals* NEWS

Number 96 in a Series of Bulletins for the Petroleum Industry

MAY-JUNE 1959

Refiner cuts TEL unloading time in half with help from Du Pont

To solve specific problems, Du Pont offers most fully rounded line of additives

Each of the additives in Du Pont's complete line was developed to overcome a precise problem or add a performance "extra" to your petroleum product. For example . . .

1. Tetraethyl Lead—For highest octanes at lowest cost. To give you fast, dependable delivery, Du Pont maintains ample stocks at 25 distribution points throughout the U.S., convenient to refiners everywhere.

2. Fuel Oil Additive No. 2 — Improve your fuel oils with Du Pont FOA-2, the additive which stabilizes heating oils, diesel fuels and residual stocks.

3. Du Pont Dyes—A complete line of oil colors for identifying grades, meeting legal requirements and for adding brand identification to your gasoline, fuel oil, lubricants and other petroleum products.

4. Du Pont Metal Deactivator—Combats copper-caused gum in gasolines, and sludge and gel formation in fuel oils.

5. Du Pont Metal Suppressor—A newly developed product uniquely effective for coating copper parts in hydrocarbon systems and thus suppressing solution of the metal into the product.

6. Antioxidants—Protect gasolines from oxidation and gum formation. Complete line offers antioxidants for every purpose, every refinery stock.

7. "Ortholeum"® 300 — Stabilizes and protects greases. It offers the combined advantages of metal deactivation and antioxidant action.

8. Additives for industrial oils and lubricants—Three widely used and highly effective additives for improving the performance and stability of industrial oils and lubricants are:

"Ortholeum" 162 lubricant assistant
PAN (phenyl-alpha-naphthylamine)
PBN (phenyl-beta-naphthylamine)

CONTINUED OTHER SIDE

IMPROVEMENTS over an old tetraethyl lead unloading line, suggested by Du Pont engineers, made it possible to lift TEL more than 16 feet from tank car to storage level. The new line has cut unloading time in half. An additional advantage is that the new line handles both motor mix and aviation mix, thereby saving some $50,000 in unneeded new equipment. Furthermore, because of the improved time factor, one shift instead of two handles all unloading.

Changes recommended by Du Pont engineers have boosted the unloading rate at one refinery from 340 lbs/min to 800 lbs/min.

Unloading time required for 6000-gallon tank cars has dropped to less than two hours. With the old setup it took from four to six hours to unload the same cars.

The switch involved was from an old two-inch line with numerous valves and fittings to a simplified three-inch line having only two valves, two ammonia elbows and three ammonia tees.

The new design was based on careful calculations of pressure drop in both the old and proposed systems by the Du Pont representative. He then advised on the construction, tested and helped to start the operation of the new system, working at all times with the refinery engineering department.

Are you taking full advantage of Du Pont engineering know-how?

You'll find Du Pont ready to go a long way in custom-engineering service to help you solve problems involving tetraethyl lead and other petroleum additives.

Customer requests for service in the past have led to such Du Pont developments and innovations as the siphon starter, valves trimmed with "TEFLON,"® Metal-Flex unloading hose, dry dye eduction systems, and a host of other developments now widely applied in the industry.

How can you get Du Pont service?

You start by phoning or writing to the Du Pont sales office nearest you (see list on back of this page). You'll get prompt and thorough attention.

®"Teflon" is Du Pont's trademark for its TFE-fluorocarbon resin.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT *Petroleum Chemicals* NEWS

CONTINUED **Complete Line**

Service also is available for the selection and handling of these additives, and in training your blending plant personnel. Your Du Pont Petroleum Chemicals representative supplies these and many other services. He's backed by a large staff of specialists in research, training, production, safety, sales promotion and advertising, men who have devoted long careers to cooperating with refiners.

Write for more information.

WEST COAST REGIONAL MANAGER

ROBERT F. HARWICK is manager of the Du Pont Petroleum Chemicals Western Region.

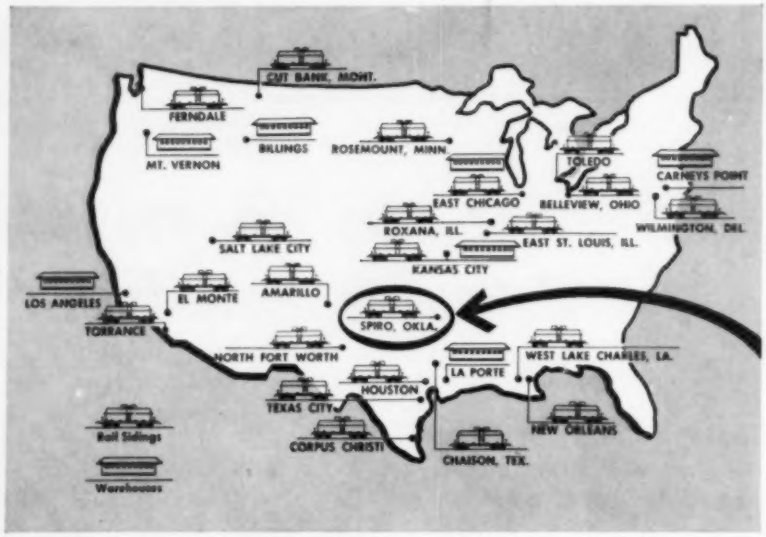
He's in charge of a variety of activities west of the Rockies. These include a Regional Sales office in Los Angeles, District Sales offices in Seattle and San Francisco, a regional laboratory and a tetraethyl lead terminal at El Monte, California, as well as additives warehouses and railway distribution centers at Ferndale, Washington; Port Costa, Antioch, Torrance, and El Monte, California; and Salt Lake City, Utah.

The new Du Pont TEL plant at Antioch makes available the TEL sold by Mr. Harwick's group.

Prior to this assignment, Mr. Harwick was the assistant manager of the Du Pont Elastomers Department's Akron office.

He brings to his job a broad range of oil industry experience, covering phases all the way from manufacturing to editorial work with a petroleum publication.

A graduate of Drexel Institute with a B.S. degree in Chemical Engineering, Mr. Harwick served for four years with the U. S. Army during World War II.



New TEL Sidetrack in Oklahoma

Now there are 22 points from which you can get emergency shipments of Du Pont TEL.

To provide even faster service to customers in Oklahoma and Southern Kansas, we are now keeping TEL on hand at a new siding at Spiro, Oklahoma.

Ample supplies of both motor mix and aviation mix are always ready to roll from all 22 sidetracks shown above. There's someone at the phone night and day at each point, ready to expedite your emergency orders.

There are also truck terminals at Carneys Point, New Jersey; Antioch and El Monte, California; Beaumont, Texas; and Ferndale, Washington, complete with weigh tanks and storage facilities, so that you can order rush shipments of TEL in less-than-tank-car quantities.

For further information on service from any of these points, contact the Du Pont Sales office listed at the right which is nearest you.

How far are you from a Du Pont additives warehouse?

Each of the seven warehouses shown on the map above is ready to make rush deliveries on any Du Pont petroleum additive whenever the need arises.

All seven maintain ample stocks of all our additives, including Du Pont Metal Deactivator, antioxidants, dyes, fuel oil additives, and grease stabilizers.

Contact any of the sales offices listed below for fastest service.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. . . . RAndolph 6-8630
Cleveland 15—101 Prospect Ave. . . . . MAin 1-3422
Houston 2—
705 Bank of Commerce Bldg. . . . . CApitol 5-1151
Los Angeles 17—612 So. Flower St. . MAdison 4-1354
New York 20—
45 Rockefeller Plaza . . . . . COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza . LOcust 8-3531
Pittsburgh 22—1 Gateway Center . . . ATlantic 1-2933
San Francisco 4—111 Sutter St. . . . . EXbrook 2-1934
Seattle 3—4003 Aurora Ave. . . . . MElrose 2-6977
Tulsa 1—1811 So. Baltimore Ave. . . . LUther 5-5578
In Canada—Du Pont of Canada Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**—Ontario . . . . . HUdson 1-6461
OTHER COUNTRIES: Petroleum Chemicals Division, Export Sales, Wilmington 98, Delaware, PRospect 4-2962.

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

Du Pont Tetraethyl Lead and other Petroleum Additives

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-10740

Printed in U.S.A.

8. Sizing New Refinery Equipment and Modifying Old Equipment

The Avon engineering department employs pilot-plant data in checking the basic designs of proposed new installations. For instance, in checking the design of a desulfurization plant the proposed charge stocks are first run in the pilot plant and data obtained on the operating conditions required to meet the desired nitrogen and sulfur contents of the products. From this information, the engineering department determines the size of compressors, heat-exchange equipment, fired heaters, towers, vessels, and other related equipment for a commercial unit.

Pilot-plant data were used with excellent results in determining the required equipment changes for the expansion of the Avon fluid catalytic cracking unit from its original 16,000-bbl per stream day to the present 50,000-bbl per stream day capacity. Product distribution and yields of the expanded unit equal that predicted from pilot-plant data.

9. Special Investigations

A. CATALYST EVALUATIONS

Before any new catalyst is accepted for use in our Avon and Delaware refineries, it is approved by the Avon research and development department. New desulfurizing and reforming catalysts are compared with other commercially available catalysts in the pilot plants under a given set of operating conditions. Desulfurizing catalysts are rated primarily on their activity for removing nitrogen. Reforming catalysts are rated on the basis of the yields at three different octane levels and the reactor inlet temperatures required to attain these octanes. Activities of spent and regenerated desulfurizing and reforming catalysts are determined from time to time. A special technique is used for evaluating cracking catalysts. New cracking catalysts are aged for 600 hours in our catalyst activity decline testing unit under simulated plant conditions and product distribution runs are made on the aged catalysts. Yields at a given conversion are then compared.

B. EVALUATION OF CRUDE-OIL PRODUCTION FROM NEW FIELDS

Crude oils from new zones and new fields of interest to the company frequently are processed through laboratory distillation equipment and the pilot plants in a manner similar to the way they would be processed in the refinery, and comprehensive reports are issued on their yields and product properties. These data are used in the computer program for evaluating new crude oils.

C. INVESTIGATION OF NEW PROCESSSING SCHEMES

The pilot plant provides an excellent means of trying out new processing schemes. An example of one of these schemes was to catalytically crack the butane-butylene stream from the fluid coker to reduce the high butadiene content of this stream. Pilot-plant tests showed that catalytic cracking of the coker butane-butylene stream under normal conditions along with gas oil effects a removal of 92 percent of the butadiene and that the liquid recovery of the coker butane-butylene fraction of the feed was approximately 95 percent. As a result of this investigation, this stream is now being processed in the catalytic cracker with the yields as predicted.

Sometimes proposed processing schemes do not prove so successful, but the cost of trying them out in small pilot plants similar to those at Avon is minor when compared to commercial scale tests. The pilot plant can, therefore, be used to screen out those ideas which, if unsuccessful in the pilot plant, would most likely stand a poor chance of working out satisfactorily in the refinery.

The Small Semiautomatic Pilot Plants

The four small semi-automatic pilot plants and the catalyst activity decline testing unit which furnish the data used in guiding refinery operations were built and are operated especially for this purpose. With this idea in mind, extra care was taken in their design in order to permit the important commercial operating variables to be duplicated in these small units so that the yields and product properties would correlate well with those obtained commercially. An example of the excellent correlation between the catalytic cracking pilot plant and the Avon catalytic cracker has been mentioned in another paper.[1] Correlations on the other units with their respective commercial plants also have been quite close.

To reduce the cost of operating these units, they were made small in size and were designed to run with a minimum of attention. Two of the units are believed to be unique in the oil industry in that they run unattended 16 hours a day. To accomplish this type of operation, more than the usual amount of automatic controls and safety devices found in most pilot plants are used.

In describing these small pilot plants and catalyst activity decline testing unit special emphasis is placed on their automatic features.

Catalytic Desulfurizing and Reforming Pilot Plant

The Avon catalytic desulfurizing and reforming pilot plant was completed in July 1954, and to date 1500 successful runs have been made on it without accident even though the unit runs unattended 16 hours per day. Residua boiling as high as 990 F at the 50 percent distillation point have been hydrogenated at 1000 psig in this unit with no attention.

The pilot plant consists of two identical units housed in a fireproof transite enclosure 5 ft wide, 9 ft long, and 10 ft high. Each unit is capable of charging 100 to 1000 ml per hour of hydrocarbon feed. Operating pressures range from 300 psig to 1000 psig, reactor temperatures from 300 F to 1000 F, and catalyst quantities from 15 ml to 250 ml. The reactors are 1 in. in diameter by 55 in. in length, and are heated in aluminum-bronze block assemblies. Each unit has its own feed tank, feed pump, reactor, high-pressure separator, debutanizing tower, refrigerated cooling system, and a gas compressor which recycles hydrogen gas from the high-pressure receiver to the catalyst. Hydrogen consumed during desulfurization is supplied from a cylinder of hydrogen.

Fire Protection

For safety during unattended operation, all parts of the pilot plant, with the exception of the gas meters, panelboard instruments, and gas cylinders, are located inside the fireproof enclosure. Because of the wide explosive range of hydrogen, a ventilating suction blower, located above the enclosure, changes the air within the housing once a minute and exhausts it through the roof of the main building.

Spaced around the ceiling of this enclosure are four spray nozzles through which carbon dioxide (CO_2) would be discharged into the chamber if a thermostat should reach a temperature of 160 F. The sudden rush of the CO_2 through the line to the nozzles operates two pressure switches; one of which shuts down the pilot plant and suction blower, and

the other which rings an alarm in the nearby physical laboratory where men are on duty 24 hours a day.

Catalyst Protection

Should the unit be automatically shut down for any reason except fire during unattended periods, a solenoid valve in the hydrogen supply line opens and allows a small flow of hydrogen to sweep the feed off the catalyst.

High and Low-Pressure Shutoff

A Mercoid pressure switch on each unit shuts down the feed pumps and compressors in case of an abnormal increase or decrease in pressure. Bursting discs vented to the outside of the building provide additional protection.

High-Temperature Limit Switch

Should something happen to cause a temperature higher than 1175 F within the unit, a limit switch on the temperature recorder shuts down the whole unit.

High-Pressure Separator Liquid-Level Safety Device

Should the solenoid valve on the outlet of the high-pressure separator fail and the liquid begin to rise in the separator, a time-delay relay working in conjunction with a capacitance-type liquid-level control relay will shut down the unit after a period of 30 sec.

Recycle Gas Electric Flow Indicator

Gas leaving the hydrogen recycle compressor passes through an electrically heated section of tubing with resultant increase in temperature. A thermocouple in the gas stream a few inches from the heated section indicates a temperature varying directly with flow. Since the section of tube where the thermocouple is located is heated only by hot gases flowing through it, any decrease in flow will result in rapid cooling of the thermocouple. This temperature drop is used to operate a contact temperature relay to actuate an alarm and shut off both feed pumps and compressors when the hydrogen circulation stops.

Electrical Control System

Two double-pole relays are used for overall control of the system. One relay, whose contacts control coil current for all the other relays, is actuated only by the high-temperature switch on the temperature recorder or by closure of the fire-control thermostat. This relay will turn off all heaters and motors of the unit. A second relay, actuated by high or low-pressure, or by the hydrogen flow indicator, will shut down the pumps and compressors but leave the heat on the unit.

Automatic Gas-Sampling Device

Each unit is provided with an automatic gas-sampling apparatus which consists of two 250-ml standard glass gas-sampling bombs, a gas-confining solution reservoir, a vertical threaded shaft driven by a small motor, an interval timer, and limit switches. In practice, the reservoir is lowered by the threaded shaft from a position above the gas-sample bombs to a position below, allowing composite samples of the product gases to be drawn into the bombs as the gas-confining solution in the bombs is drained off. The sampling time is set by the timer. Cam-operated limit switches stop the motor after each revolution of the shaft. At selected intervals the timer momentarily shorts the limit switch allowing the shaft to make another revolution. This occurs 360 times to completely drain the bomb, giving, in effect, 360 spot samples in any selected total time.

Additional Controls

Additional controls are being installed on this unit to permit weight-balance runs to be started automatically during the night.

Fluidized Fixed-Bed Cracking Catalyst Activity Decline Tester[2]

As originally designed, the testing unit was a fixed-bed reactor for aging pelleted catalysts. In 1953 it was converted to a fluidized fixed-bed reactor for aging catalysts screened to 60-200 mesh. A typical aging run on the present unit requires 6 weeks' time, 15 gal of catalytic cracker charge stock, and 300 g of screened catalyst. The operation is cyclic and is repeated every 30 min, 24 hours a day, until the catalyst is aged 600 hours. The normal temperatures are 965 F for reaction and 1150 F for regeneration.

The testing unit is housed in a fireproof transite enclosure 4 ft wide, 8 ft long, and 10 ft high, and is equipped with automatic fire-protection and shutdown equipment similar to that used in the desulfurizing and reforming pilot plant. The main equipment inside the enclosure consists of a feed tank, a gear pump which pumps 12 ml per min of feed during the reaction cycle, two positive-displacement water pumps for supplying the dispersion and stripping steam, a feed preheater, a vessel in which the reaction and regeneration takes place, and a product-handling system which includes a refrigerated water knock-back condenser and a debutanizing column. The reactor regenerator vessel is about 30-in. long and is made of 1½-in. pipe with a 4½-in.-long, 3-in.-diameter expanded section at the top. This vessel is stainless steel and is lined with a 0.01-in. thick coating of alumina to prevent rusting. The filter inside the vessel used to confine the catalyst is made of porous porcelain. The stainless-steel filter previously used caused nickel poisoning of the catalyst samples and made the results inconsistent from one run to another.

Program Cycle Timer

The mechanical brain that operates the unit is a program cycle timer with 12 cams. It controls the flow of feed and dispersion steam during the 2.86 min reaction cycle, steam during the 3.90 min stripping cycle, air during the 10.00 min regeneration cycle, and nitrogen during the 13.24 min purge cycle. In doing this, the program timer opens and closes, in sequence, the magnetic and air motor valves, as well as starting and stopping feed and water pumps. The cycle timer also regulates the regeneration temperature by introducing an adjustable external resistance in the measuring circuit of the reaction temperature controller. It automatically controls the pressure at 18 psig during regeneration and at atmospheric pressure during all the other cycles by operating a bypass valve around a pressure-regulated valve.

High-Pressure Shutoff

The reactor and feed lines are protected from excessive pressures by Mercoid pressure switches which shut the unit down. Bursting discs on the reactor and feed line provide additional protection.

Dehydrator Manometer

A connection on the product line directly before the dehydrator leads to another manometer. It is possible for the calcium sulfate drier or wet-gas condenser to plug up and raise the back pressure on the glass debutanizer column to a point where it could break. To prevent this condition, the mercury manometer closes an electrical circuit when the

Where do you fit

in the changing petroleum picture?

records show that 294 refiners have tripled average production—but 160 have succumbed to competition

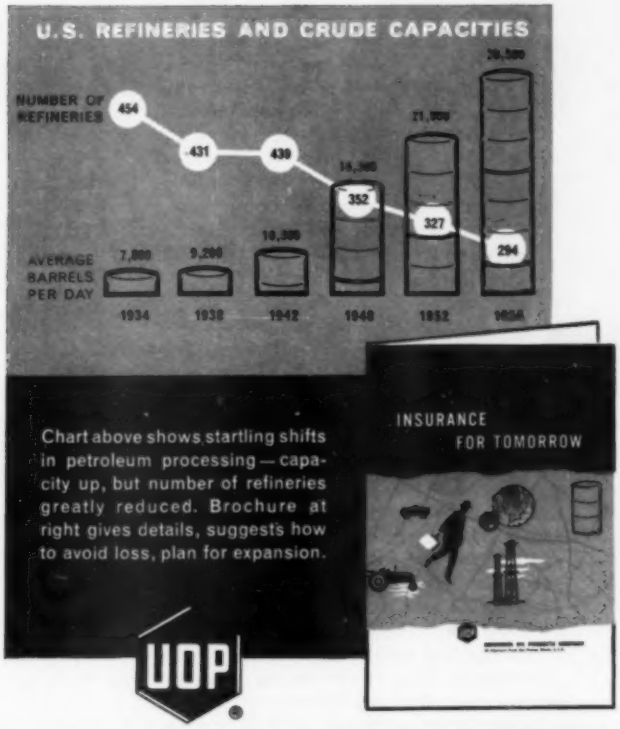


Chart above shows startling shifts in petroleum processing—capacity up, but number of refineries greatly reduced. Brochure at right gives details, suggests how to avoid loss, plan for expansion.

Drastic changes in transportation by road, rail, water and air constantly keep petroleum refiners on their toes. Adding to the complexity of the petroleum refiner's problem are never-ceasing changes in the nature and location of his crude supplies, and of markets for his products.

In this situation there are certain things the refiner can do to avoid losses and capitalize existing opportunities—to utilize his facilities and market potentials to the fullest.

As an aid to intelligent planning, the Economic & Market Research Department of Universal has prepared a bulletin entitled, "Insurance for Tomorrow." It shows how Universal can help coordinate the application of processes to achieve the most economic operation. Send for your copy today. Just fill out and mail the coupon.

UNIVERSAL OIL PRODUCTS COMPANY 30 Algonquin Road, Des Plaines, Illinois, U.S.A.

More Than Forty Years Of Leadership In Petroleum Refining Technology

GENTLEMEN:

Please send me your bulletin, "Insurance for Tomorrow." I understand there is no charge or obligation.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

pressure reaches 6 lb. A reset relay is then energized which shuts off the power to all parts of the unit except the temperature recorder. Simultaneously with the shutting down of the unit, a solenoid valve opens and releases the pressure on the dehydrator to a vent line.

High-Temperature Limit Switch

Should something happen to cause a temperature higher than 1175 F within the unit, a limit switch on the temperature recorder shuts down the unit.

Midget Fluid Catalytic Cracking Pilot Plant

The Midget catalytic cracking pilot plant[2] is used primarily for evaluating feedstocks but also is used to study operating variables. The normal operation is once-through but also can be run under recycling conditions. A complete evaluation at one reactor temperature can be made with 3 gal of feed.

The pilot plant is 16 ft long, 12 ft high, and 3 ft wide. It consists of a feed pump, two water pumps for dispersion and stripping steam, a cracking assembly, a product-handling system, and recycle equipment.

The unit operates at atmospheric pressure and at feed rates from 150 to 1000 ml per hour. Reactor temperatures have been studied in the range of 895 F to 1025 F. The normal regeneration temperature is approximately 1075 F, but is adjusted at the beginning of a run to obtain 0.2 to 0.3 percent by weight carbon on the regenerated catalyst so as to conform with commercial practice. Dispersion and stripping steam rates are adjusted to approximate those used commercially. The catalyst inventory of 3 lb of plant equilibrium catalyst, screened to 60-250 mesh, is circulated at rates of 4 lb to 9 lb per hour to maintain a catalyst-to-oil ratio of 7:9.

Cracking Unit Assembly

The cracking unit is located in a radiant furnace with the catalyst hopper at the top and the regenerator, reactor, and stripper directly below. The regenerator is 21 in. long and 3 in. in diameter. The reactor is 15 in. long by 1½ in. in diameter and the stripper is 13 in. long by 1½ in. in diameter. Both the regenerator and reactor have expanded sections at the top and are equipped with small cyclones to separate the catalyst from the overhead vapors.

Outside the furnace and at the bottom of these vessels is the catalyst lift unit. This is an aspirator which employs a nitrogen jet to lift the catalyst through a ⅜-in. tubing to the hopper at the top of the unit. The catalyst circulation rate is regulated by positioning the nitrogen jet in the lift unit. When the circulation stops, a thermocouple on the catalyst lift line operates a contact temperature relay to actuate an alarm.

Product-Handling System

The reactor effluent is dehydrated and debutanized continuously in the product-handling system. Steam in the reactor effluent is condensed and removed automatically by means of an overflow device on the overhead condenser on the dehydrator column. The liquid holdup in the dehydrator and debutanizer reboilers is only 230 ml. This makes it possible to start up, reach equilibrium conditions, take samples, and shut down in 8 hours.

High-Temperature Shutoff

During the night, while the pilot plant is idle and unattended, all the vessels in the cracking assembly are controlled at 700 F to speed up the start the following morning. To protect the equipment a high-temperature limit switch on the main temperature recorder shuts off the heat if any temperature exceeds 1175 F. To save chart paper, a flexopulse timer starts the recorder every 5 min and allows it to run for 20 sec while it scans all the temperature points and then shuts it off.

Recycle Equipment

The recycle equipment consists of two small fractionating columns and two pumps. The column which separates the heaviest fraction of the cycle oil is made of 1½-in. tubing, 11 in. long, with a 3¾-in. long flanged-glass cylinder reboiler to withstand the 740 F temperature. The second column which separates the recycle stock is made of 1-in. tubing, 23 in. long, with a 100-ml glass flask for a reboiler. Synthetic crude oil from the bottom of the debutanizer is pumped into the first of the two columns. The liquid holdup in the product-handling system and recycle equipment combined is only 550 ml.

Fluid Coking Pilot Plant

Since the fluid coking process was new when the pilot plant was built and not too much was known about recycle operation, the initial work was to determine the effect of operating variables on product quality and yields under recycle conditions. The unit is now being used to obtain yields and product properties on various heavy vacuum residua and flashed heavy crude oils to furnish data for the IBM 650 refinery simulation program.

The pilot plant charges from 1 to 4 gal per hour of feed and uses 50 lb of 40-100 mesh fluid coke in the reactor. Reactor temperatures from 950 F to 1050 F have been used. Most of the important operating variables used in the commercial unit can be duplicated in the pilot plant.

The pilot plant consists of a feed-drum heater, feed pump, feed preheater, reactor, recycle separator, recycle and quench pumps, steam generators, water knockout system, gas-oil tower, and debutanizing column. The reactor-recycle separator and pump assembly is 11 ft high and occupies a floor space 2 ft by 5 ft. The reactor itself is a 2-ft long section of 12-in. pipe with a conical bottom and flanged at the top. The recycle separator located above the reactor is a 3-in. ID column, 34 in. long, packed with raschig rings and helices.

In operation, feed and recycle at approximately 400 F enter a single feed nozzle near the bottom of the reactor. Steam, superheated to 1050 F, passing through this nozzle atomizes the feed and spreads it out in a thin film over the 950 F fluidized coke particles. The cracked vapors and unconverted feed escape along with the steam into the recycle separator. Here the reactor effluent is quenched to 760 F and the high-boiling, unconverted material is separated and recycled back to the reactor. The overhead from the recycle tower then is condensed and the water removed by a capacitance-type relay liquid-level control. After reheating, the gas, oil, gasoline, and gas are separated in the gas-oil and debutanizing towers. As the coke level rises in the reactor, as a result of coke being produced, it is withdrawn through a lock system connected to the reactor at the top of the bed.

Although this pilot plant has fewer automatic controls than the others, it runs with a minimum of attention. One man can start it up, take the samples, and shut it down by himself.

References

1. C. K. Viland, "Better Yields After Nitrogen Removal," *Petrol Refiner* 37 [3] 197-200 (1958).
2. C. K. Viland "Evaluation of Cracking Catalysts," *Petrol Processing* 8 [12] 1874-79 (1953).
3. C. K. Viland, "Midget Cracker Helps Big Brother," *Petrol Processing* 6 [12] 1370-73 (1951).

Stainless Steel pipes cool hot acid

AT SINCLAIR REFINING COMPANY,
HOUSTON, TEXAS

This continuous SO_3 sulfonization unit produces a high detergent lube oil additive. The picture shows Type 316 Stainless Steel pipes in the cooler. 98% sulfuric acid enters the coils at about 145°F and is cooled to 105°F by water.

The pipes take punishment three ways: high temperature, acid corrosion, and erosion. At first, some of the pipes were made of a less resistant metal but they had to be replaced with Stainless Steel after only eight months. There has not been one sign of deterioration in the replacements or in the Stainless Steel pipes installed originally.

When you install equipment, design it with the right material from the start. If you need strength and corrosion resistance, there is no metal that can match the performance and economy of Stainless Steel. Order USS Stainless Steel through your U. S. Steel representative or your local Steel Service Center.

USS is a registered trademark

United States Steel Corporation – Pittsburgh
American Steel & Wire – Cleveland
National Tube – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

USS United States Steel

DISTILLATION . . .
in View of Modern Developments

. . . A Series on Recent Developments in Distillation and Absorption Techniques

Part 1: Phase Equilibric and Thermo-dynamic Concepts

CHAPTER 1B — Phase EQUILIBRIA

. . . TERNARY EQUILIBRIA

Kenneth F. Gordon and **James A. Davies**
University of Michigan, Ann Arbor, Michigan — *The Texas Company, New York City*

TERNARY EQUILIBRIA

In a binary system at a given temperature and pressure, the vapor and liquid compositions are fixed but not in a ternary. Application of the phase rule will show three degrees of freedom available with only two being used by setting the temperature and pressure. Ternary diagrams are frequently employed to understand better how compositions may vary at constant temperature. There are two ways of representing ternary equilibria, one on triangular coordinates, usually equilateral, and one on rectangular coordinates. An example of the latter is shown on Fig. 1 where compositions of A and B are shown free of C along the obscissa and the amount of C per (A + B) is shown along the ordinate in either mole or mass fraction units. This method, frequently used in liquid extraction work, is similar to that of Ponchon.

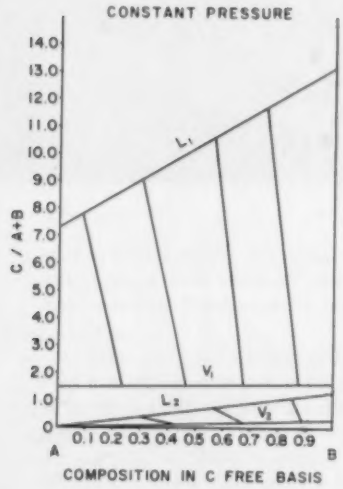


FIG. 1. Ternary Ponchon from Fig. 3.

The usual representation for distillation work is the equilateral triangular diagram. Before showing examples, it might be well to review some of the fundamentals of an equilateral triangle that are important as illustrated in Fig. 2.

1. The sum of the perpendicular lines from a point, P, to the sides equal the length of one side. Thus, line Pa represents the amount of A in the composition represented by point P.

2. The relative amounts of A to B are unchanged going from N to C along line CN.

3. If P is made up of two fractions of compositions shown by F and M, then the relative amount of F is given by the distance MP and the relative amount of M by PF. This is the lever arm rule.

4. The equation for a straight line is given by:

$$\frac{x'_c - x_c}{x_B - x'_B} = m$$

where m is a constant and the prime refers to a particular point.

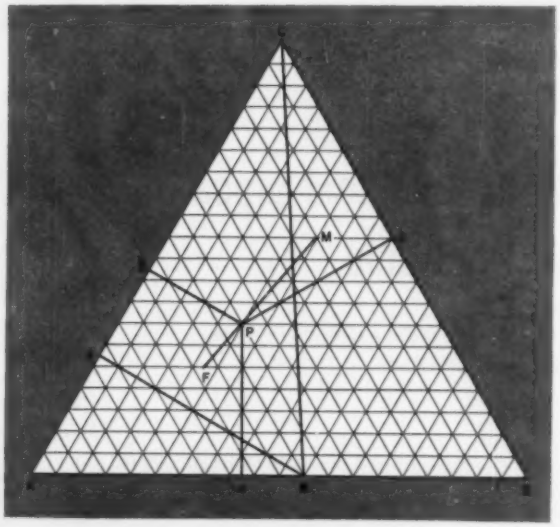


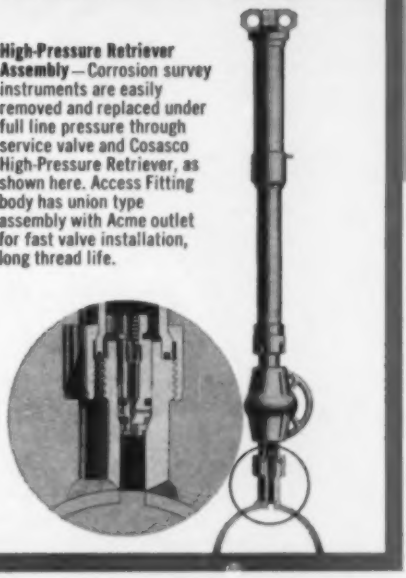
FIG. 2. Ternary diagram.

Positive, accurate DETECTION is your best corrosion protection

COSASCO®

...your key to complete corrosion control without system shutdown!

High-Pressure Retriever Assembly—Corrosion survey instruments are easily removed and replaced under full line pressure through service valve and Cosasco High-Pressure Retriever, as shown here. Access Fitting body has union type assembly with Acme outlet for fast valve installation, long thread life.



Cosasco offers the *only* complete line of corrosion survey instruments for *all* pressure conditions—up to 10,000 psi! Now you can insert and retrieve corrosion coupons, samplers, thermocouples and probes under full line pressure, without interfering with normal operations in any way. The patented Cosasco Access Fitting principle is your key to positive, accurate corrosion survey programs in transmission, storage, injection, recovery and processing equipment—at all times and under all conditions!

Free Corrosion Survey Service. If you have a corrosion survey problem, Cosasco can help you solve it. Send details and blueprints and the Cosasco solution will be worked out promptly—at no cost to you.

Cosasco offers complete line of "use-engineered" corrosion survey instruments. In representative group shown above are (l to r): Thermocouple Survey; Product Sampler; Corrosometer* Probe; Hydrogen Probe (Chiksan swivel type); Hydrogen Probe (Standard type); Disc-type Coupon Holder (bottom of line application); Coupon Holder (Standard inside register type); Coupon Holder (Extension tongue type); Pre-Stressed Coupon Holder.

*T.M. REGISTERED

COSASCO®
DIVISION
PERFECT CIRCLE CORPORATION
11655 McBEAN DR., EL MONTE, CALIFORNIA
EXPORT OFFICE: 5631 ATLANTIC AVENUE, LONG BEACH, CALIFORNIA

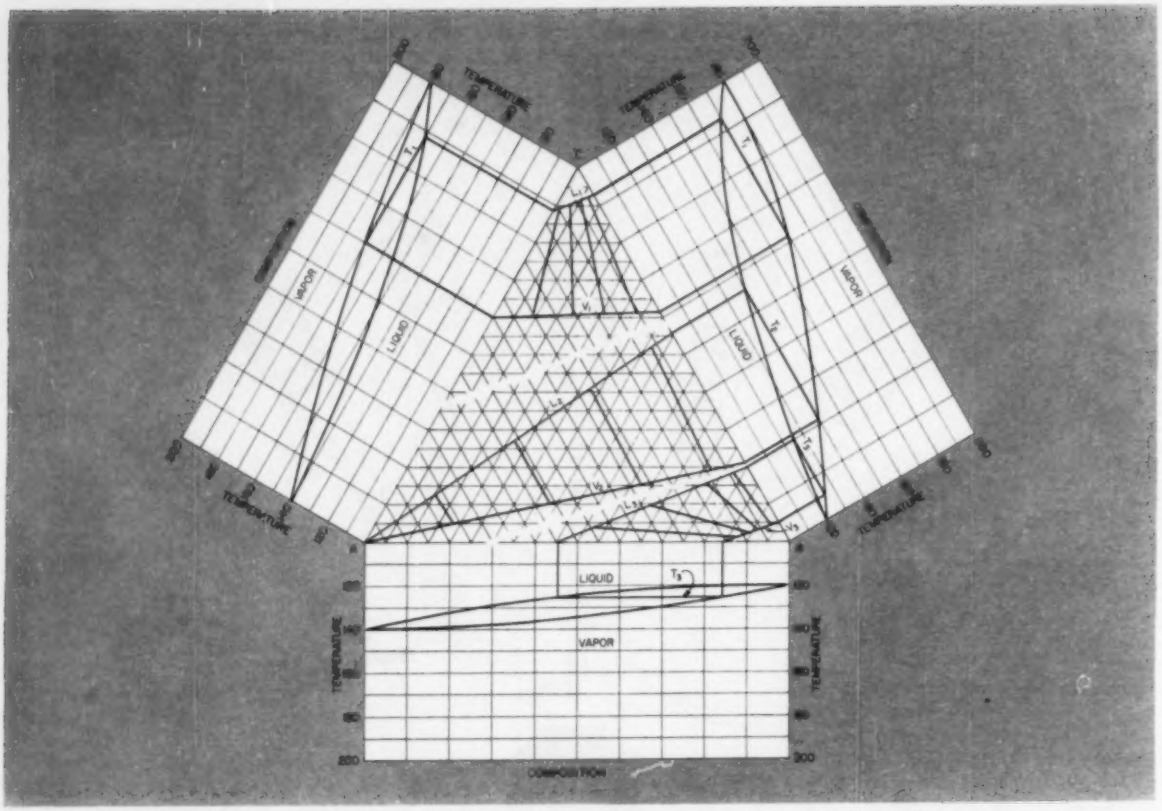
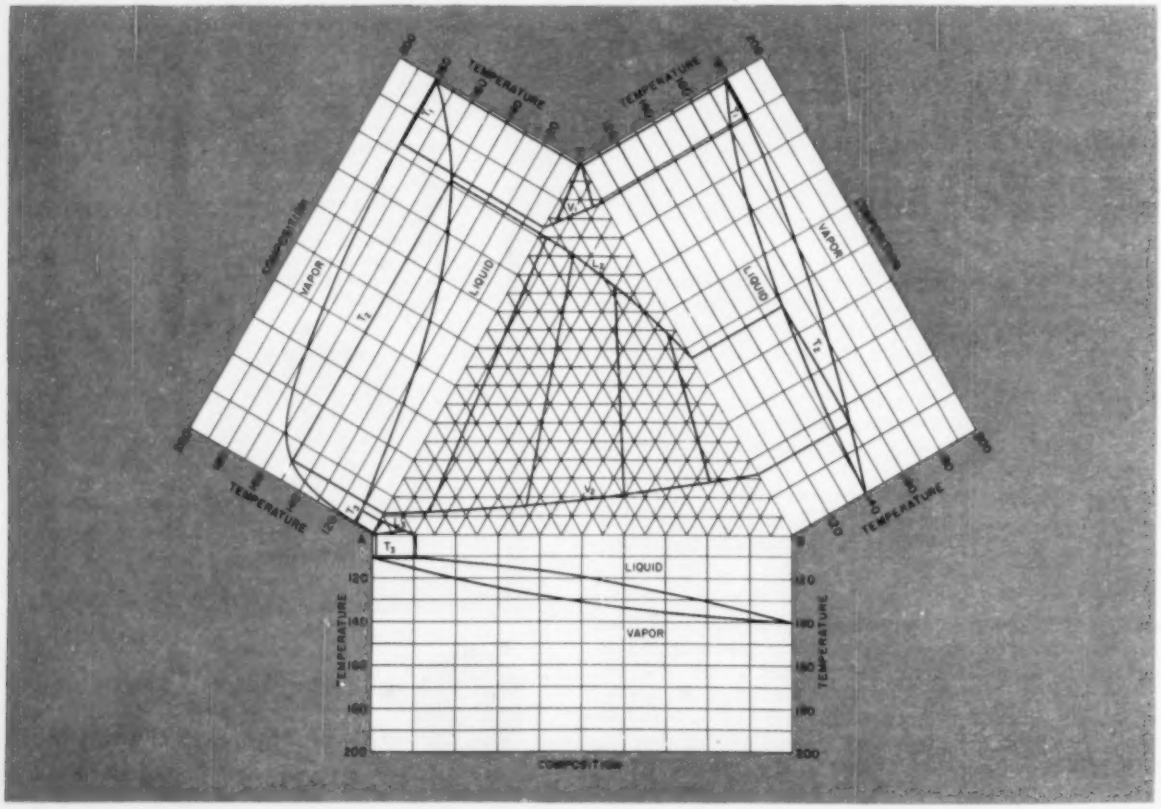


FIG. 3. Ternary vapor-liquid equilibrium at constant pressure — ideal case.

FIG. 4. Ternary vapor-liquid equilibrium at constant pressure — non-ideal binary.



How B&W JOB-MATCHED TUBING saves in oil heater applications

... A complete range of carbon, alloy and stainless steels—permits choice of steel to match service conditions.

... A wide size range—provides for freedom of design.

... Uniform dimensions and mechanical properties — helps to provide ease of fabrication.

These are just a few of the reasons it pays to specify B&W Job-Matched Seamless Pressure Tubing. Call the tubing specialist at your local B&W District Sales Office, or write for Bulletin TB-417 for full information. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9016-SP2

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

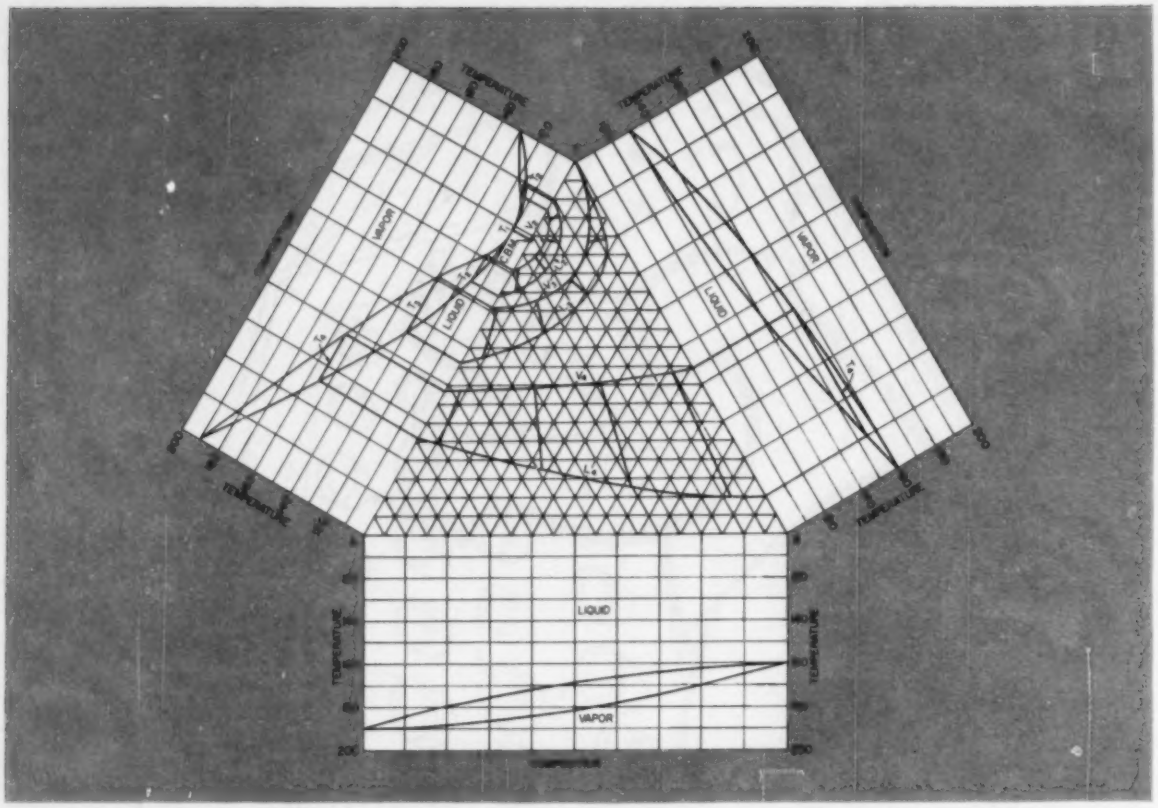
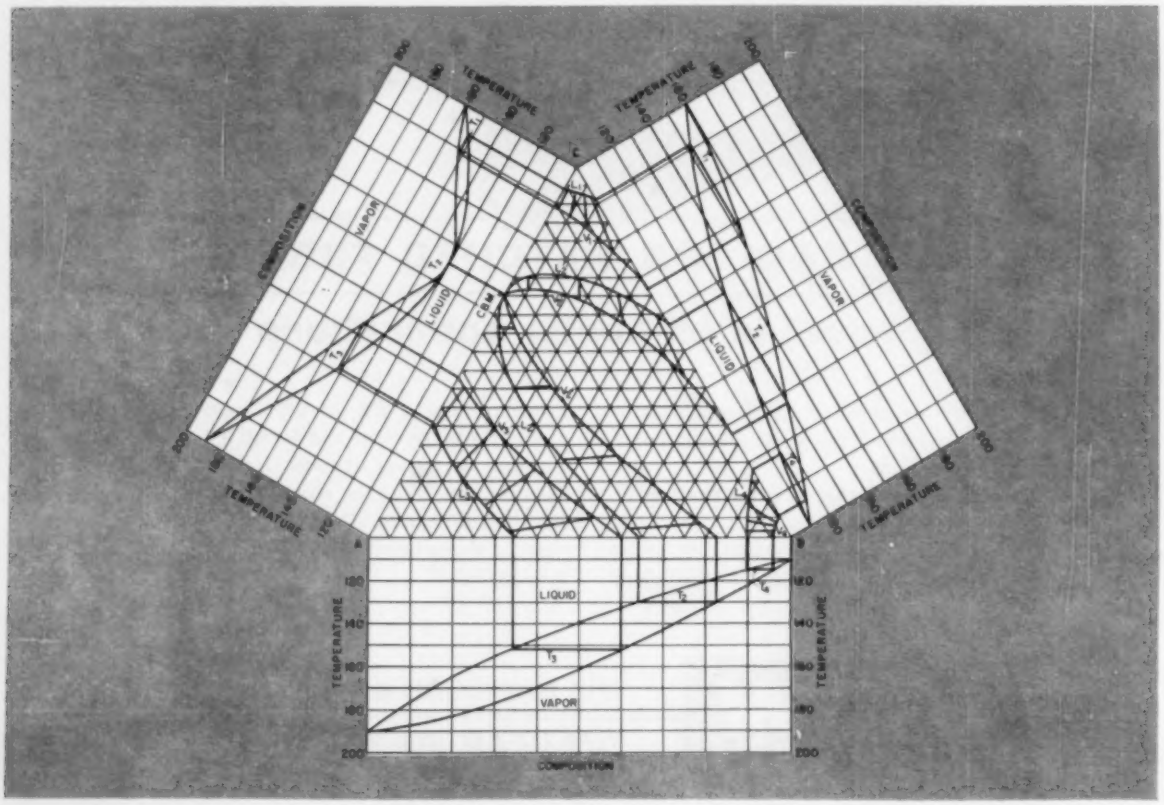


FIG. 5. Ternary vapor-liquid equilibrium at constant pressure — binary azeotrope at low temperature.

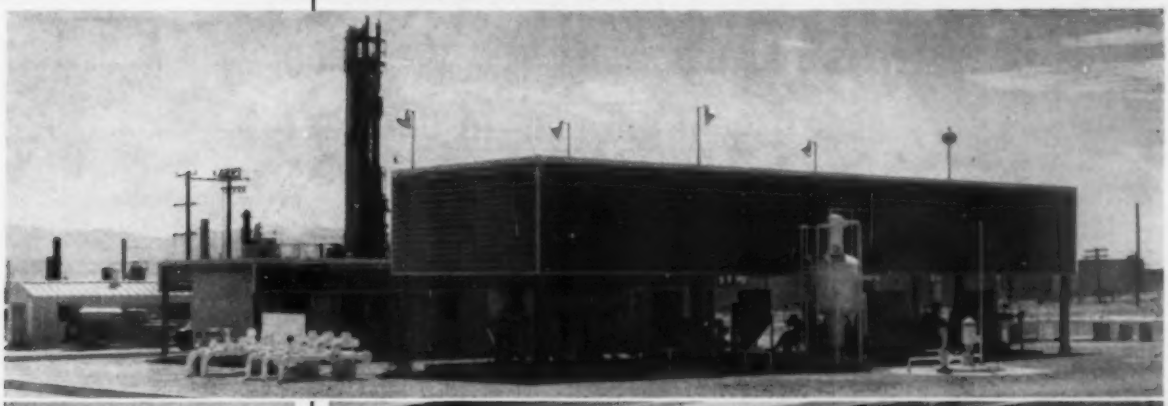
FIG. 6. Ternary vapor-liquid equilibrium at constant pressure — binary azeotrope at intermediate temperature.

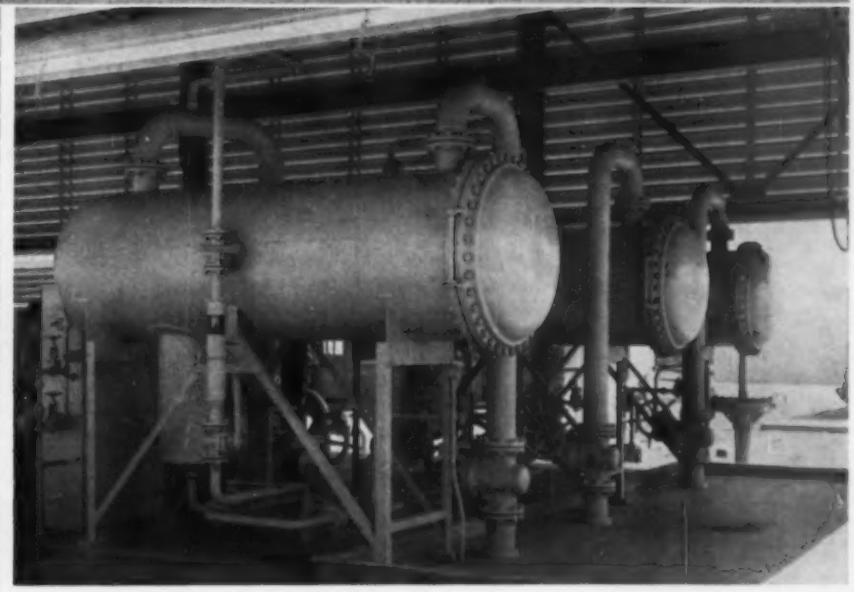


SOUTHERN PACIFIC PIPE LINES, INC.

select EXCEL-SO

water separators and meter calibrating tanks*





WARNER LEWIS COMPANY

BOX 3096 • TULSA, OKLAHOMA

DIVISION OF
FRAM CORPORATION

These two famous EXCEL-SO pipeline products insure maximum product cleanliness and meter accuracy— eliminate costly corrosion and meter repairs

High volume strainer/separators and large capacity meter calibrating tanks for a complete range of petroleum products—all in high pressure design where required—a specialty with the Warner Lewis Company. Years of experience in design and fabrication of this equipment for pipeline service are available for assistance in planning your installation. Write Warner Lewis Company for further information.

Representatives in all major cities
In Canada, Fram Canada Ltd.
Stratford, Ontario

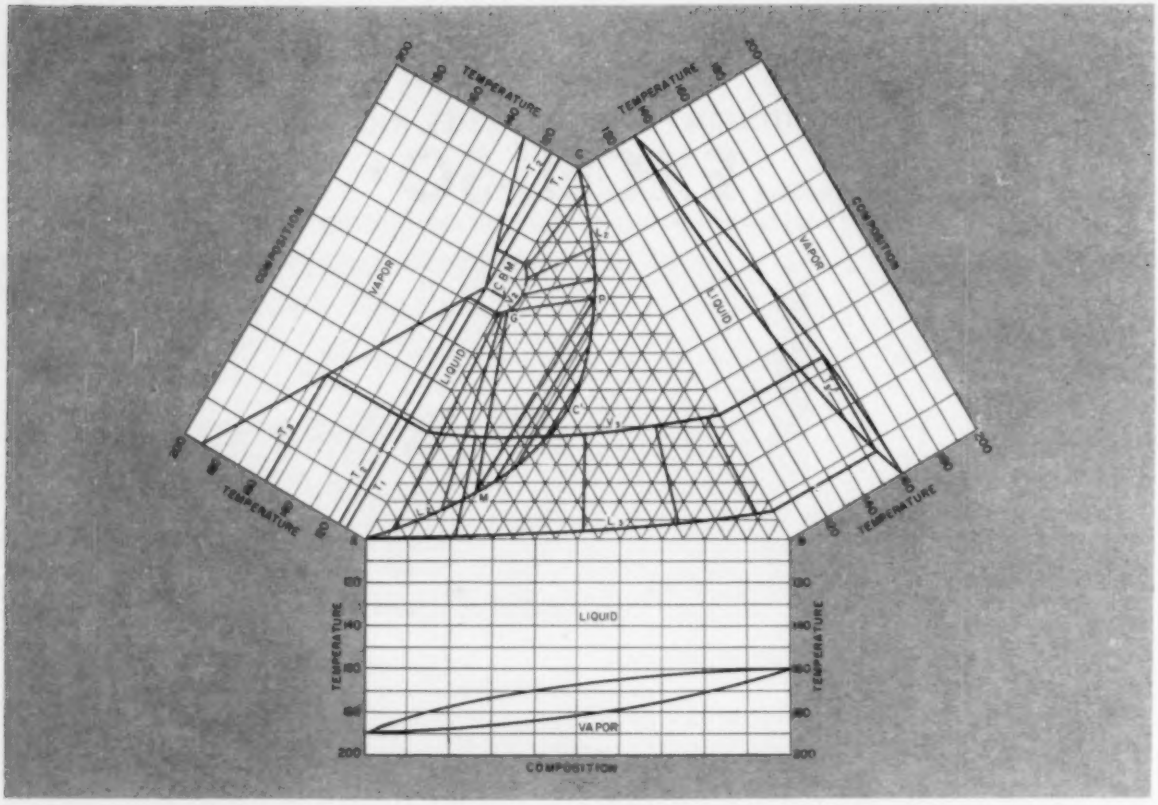


FIG. 7. Ternary vapor-liquid equilibrium at constant pressure — binary heterogeneous azeotrope.

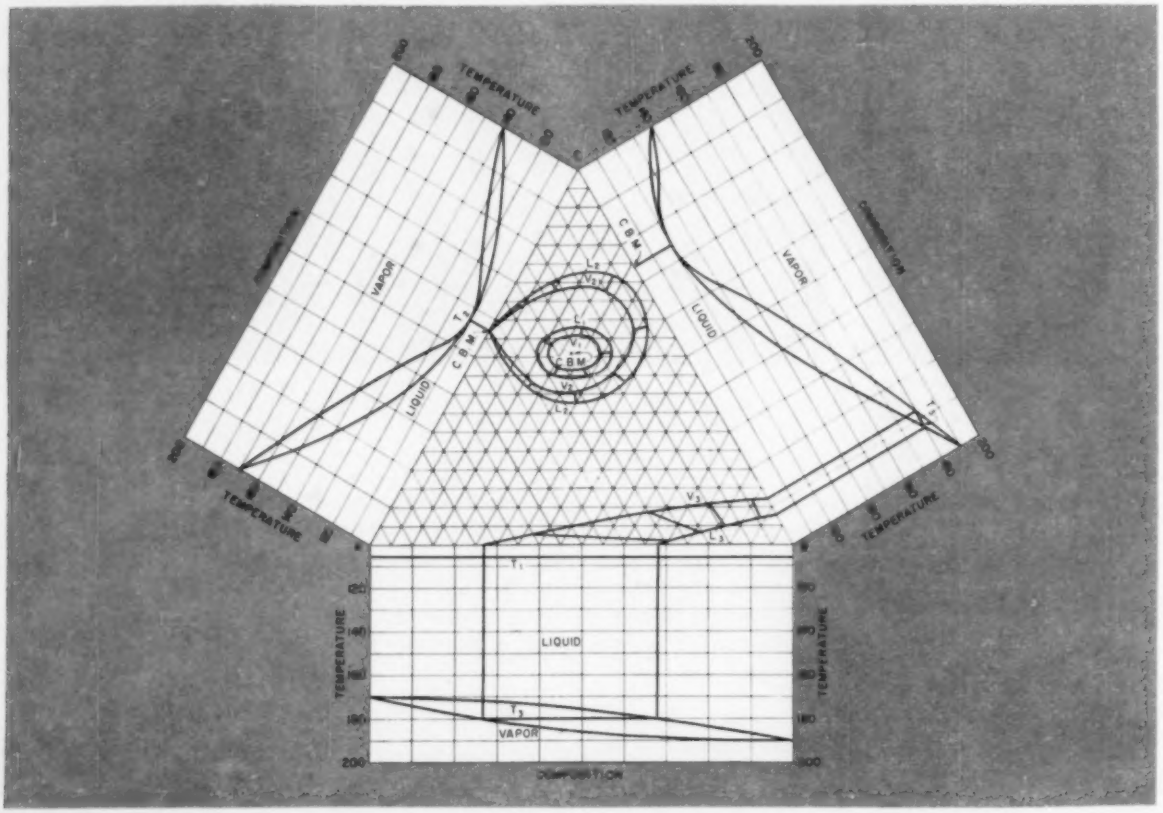
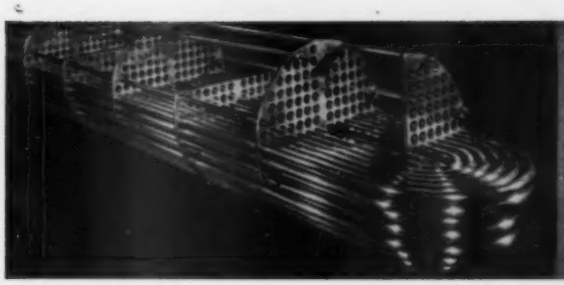


FIG. 8. Ternary vapor-liquid equilibrium at constant pressure — ternary and two binary azeotropes.



CONDENSER AND HEAT EXCHANGER CLINIC

Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Buffalo 5, New York

New tube mill equipment gives designer of heat-transfer units freer hand in meeting new trends

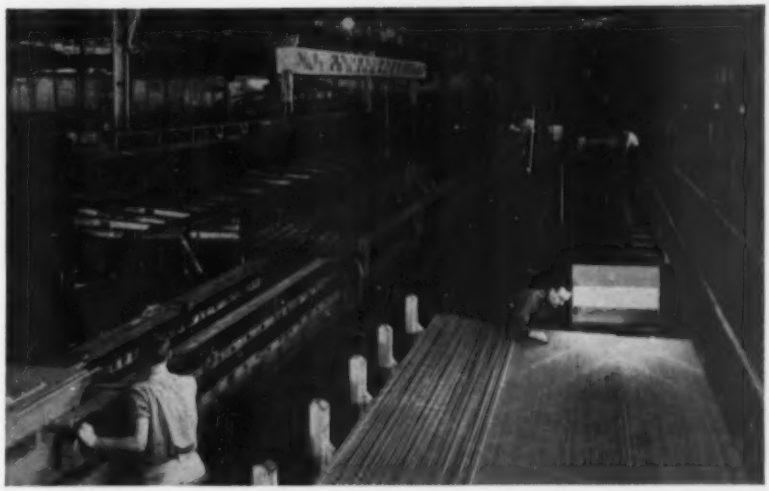
With the installation of new production and testing equipment, The American Brass Company now offers the most complete service available to users of condenser and heat exchanger tubes.

Long lengths. To gain advantages in construction, processing, or installation, designers can lengthen equipment considerably. Tubes can now be drawn up to 100 feet. Most of the longer tubes are required as U-bends, but in some instances may be shipped as straight lengths.

U-bends. Tubes from ⅜" O.D. to 1½" O.D. with wall thicknesses from .049" (18BWG) to .134" (10BWG) can be bent on a radius of from 1¼ times the tube O.D. to 30".

Dual Gage. Where high temperatures and pressures are involved, it may be desirable to thicken the tube wall in the area of short-radius bends on U-bend tubes. Walls are thickened one Stubs' Gage No. to compensate for thinning of metal in the bending.

Thickened Tube Ends. To compensate for thinning by rolling or by impingement corrosion caused by high velocities, tubes may be supplied with the wall thickened at one end one or more Stubs' Gage Nos. The extra thickness may be on the outside or inside of the tube as required.



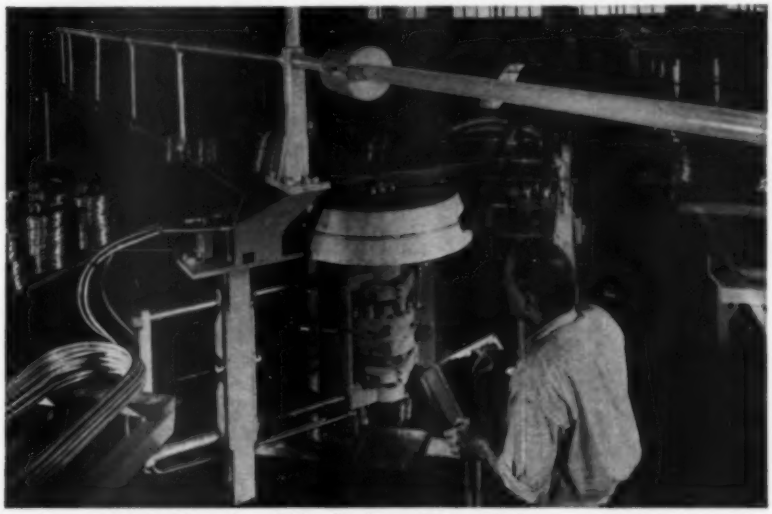
GENERAL VIEW of new American Brass Company equipment which can draw copper and copper alloy tubes in lengths up to 100 feet.

Relieving Stresses. All U-bend tubes, other than copper, are annealed at the bend area after bending, to eliminate the hazard of stress-corrosion cracking which might occur in service due to stresses that may exist as a result of the bending.

Testing. U-bends are tested hydrostatically at ASTM Specification pressures —or at ASME Code pressures up to 6000 psi on request, if the tube size will stand it. Electronic inspection with eddy-current equipment is available also, when required.

Shipping. U-bend tubes are shipped packed for ease in handling and storage.

Technical Assistance. For more detailed information on extra-long tubes, U-bend, Dual-gage, or Duplex tubes to meet special problems, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Limited, New Toronto, Ont. 5057 Rev.

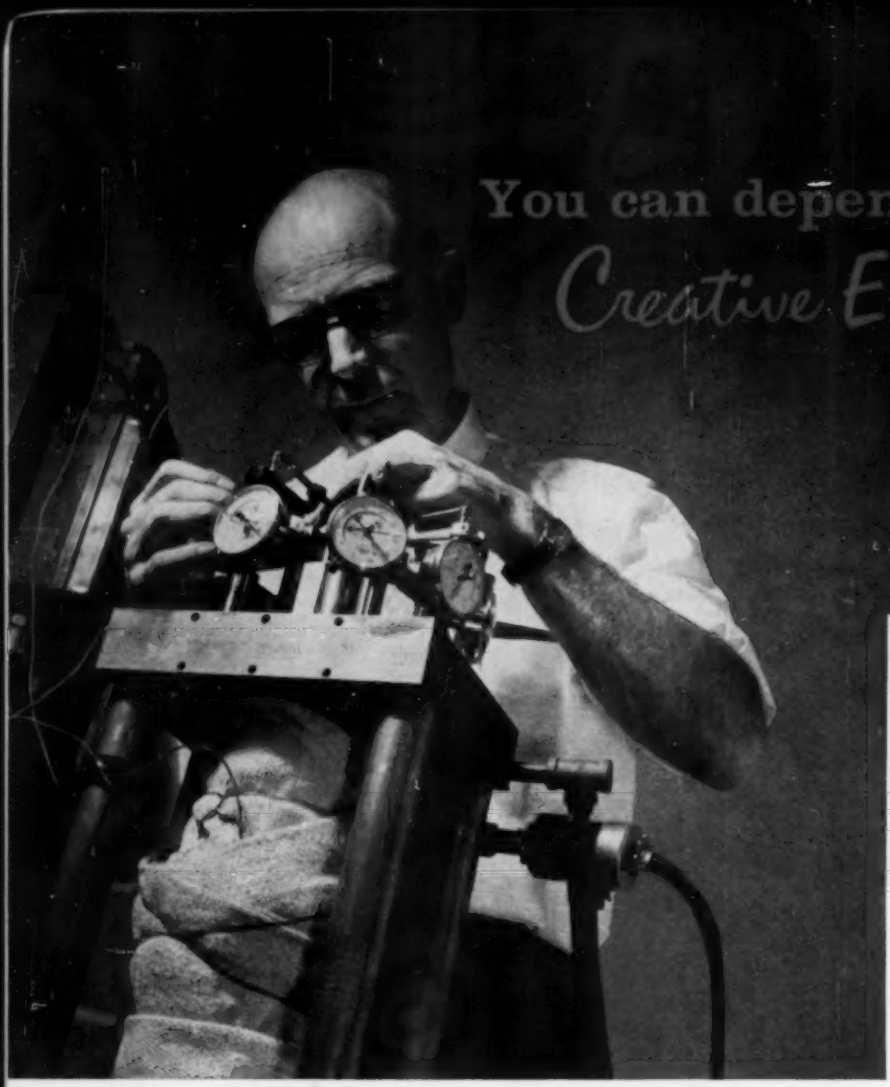


BENDER CAN produce U-bend tubes with straight leg up to 50' long.

ANACONDA®

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS

Made by
The American Brass Company



You can depend on W-K-M's *Creative Engineering*

W-K-M
Through-Conduit
Gate Valves for
Oilfield Service
Catalog 200

W-K-M
Through-Conduit
Gate Valves (ASA)
Catalog 300

ACF Lubricated Plug
Valves (Semi-Steel)
Catalog 400
(Steel)
Catalog 1100

ACF
Non-Lubricated
Ball Valves
Catalog 1000

KEY Refinery Fittings
and Return Bends
Bulletin KR-1257

KEY-KAST Alloy
Welding Fittings
Bulletin KK-1057

KEY Pipe Joint
Compounds
Circulars 239-B
and 240-B

W-K-M Slips and
Spiders
Catalog 200

W-K-M creative engineering gives you the benefits of continuous research and development . . . of skill and care in production . . . of thorough testing, in the laboratory and in the field.

W-K-M's leadership in its special fields results from research into your most difficult problems and the development of practical solutions that meet the most exacting demands of performance, easy operation and economy.

W-K-M design, materials and workmanship establish quality standards that are rarely equaled, never surpassed. Testing is continuous and rigorous.

Specify W-K-M with confidence—*you can depend on W-K-M's creative engineering.* For complete information covering W-K-M products, write for the literature indicated at right.

Engineered for Dependability and Long-Range Economy

W-K-M Division of ACF Industries, Incorporated,
P. O. Box 2117, Houston 1, Texas

W-K-M 40 SERVING INDUSTRY YEARS

W-K-M, ACF, KEY, KEY-KAST
are registered trademarks of ACF Industries, Incorporated

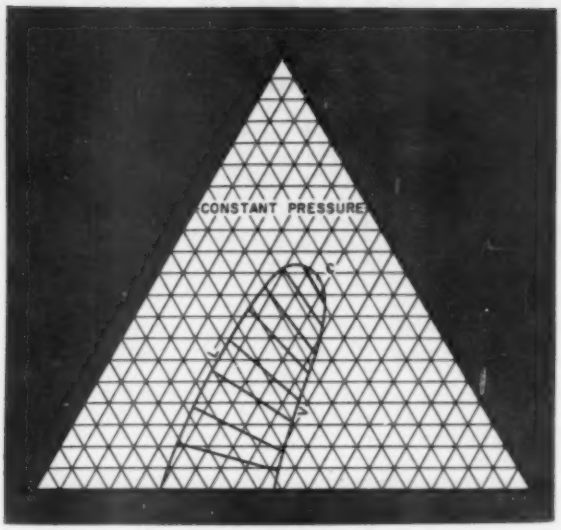


FIG. 9. Ternary critical region.

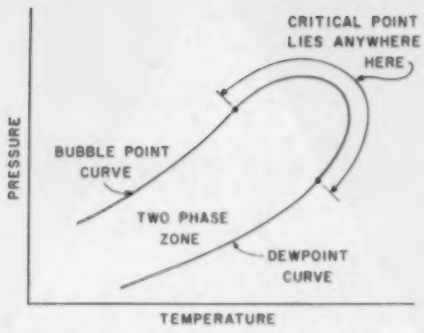


FIG. 10. Two phase zone for a system of a fixed composition.

Referring to Fig. 2 the equation for line CN would be:

$$\frac{x'_c - x_c}{x_B - x'_B} = m = \frac{1}{AN} = \frac{1}{0.55}$$

where the length of the line AN gives the concentration of B at point N.

It is sometimes useful to plot ternary equilibrium values measured or calculated against temperature using m as a parameter or against m using temperature as the parameter. For instance in Fig. 5, if a family of straight lines radiating from the azeotrope point were used for plotting the data, there would be only one equilibrium value at a given temperature and m value.

Fig. 3 through 8 give typical examples of the ternary diagrams, also showing their relationship to the corresponding binary diagrams. Fig. 3 is an ideal case. Fig. 4 has a non-ideal binary, AC. Note here that the dew-point and bubble-point curves are more curved than for the ideal case where they are practically straight. Fig. 5 has a binary homogeneous azeotrope for AC that boils below any component. Fig. 6 is similar but the azeotrope boils above component B. Fig. 7 is similar to Fig. 5 except that there is a heterogeneous azeotrope. It will be noted that at temperature T_2 there is a three phase region bounded by GMP with two liquids, M and P, and a vapor G. The region MPC′ is the condensed, two liquid phase region. Point C′ is the critical solution point. Fig. 8 shows a system with azeotropes in two binary systems and the presence of a ternary azeotrope. If there are two binary azeotropes with close boiling points, one would expect a ternary azeotrope to exist as well.

While ternary diagrams are useful in helping to understand distillation of abnormal systems such as azeotropes, binary diagrams for the critical region are much easier to interpret than ternary diagrams. Fig. 9 shows the critical region at a constant pressure. As shown in Fig. 10, for a system of fixed composition, the P – T diagram looks the same for milticomponent systems as it does for the binary. The critical point can be anywhere along the curve as indicated.

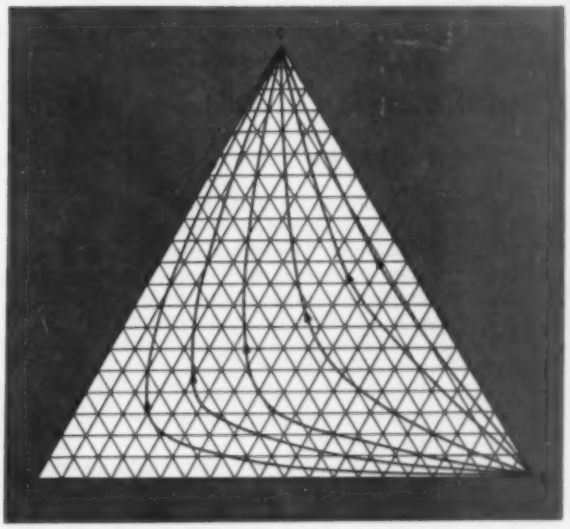


FIG. 11. Simple distillation curves, mixture corresponds to Fig. 3. Liquid compositions at constant pressure.

Distillation Curves

There are three different methods that are common in effecting separation by distillation. These are briefly as follows:

1. **Simple distillation.** Vapors formed upon boiling the mixture are immediately withdrawn from the vicinity of the boiling liquid. Simple distillation occurs when boiling liquids in open containers without reflux. In evaporation processes, unlike simple distillation, the relative rates of transfer depend on the molecular diffusivity of the components.

2. **Batch distillation.** Reflux contacts the vapors, and the liquid charge in the still is boiled down to the desired separation, no new charge being added during the distillation. Most laboratory distillation work is carried out batchwise.

3. **Continuous distillation.** The charge is continuously introduced to the distillation column, which has reflux

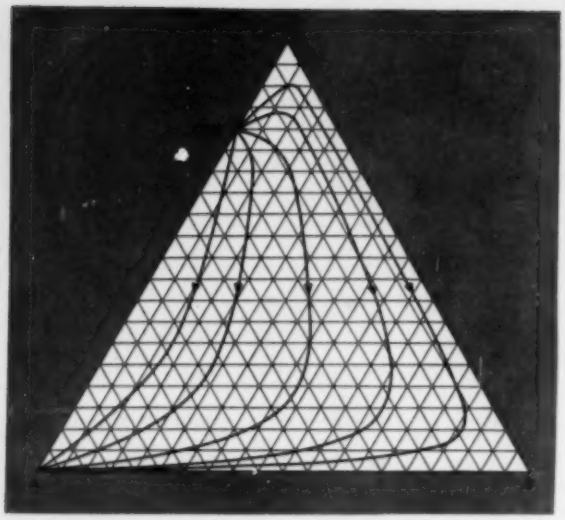


FIG. 12. Simple distillation curves, mixture corresponds to Fig. 5. Liquid compositions at constant pressure.

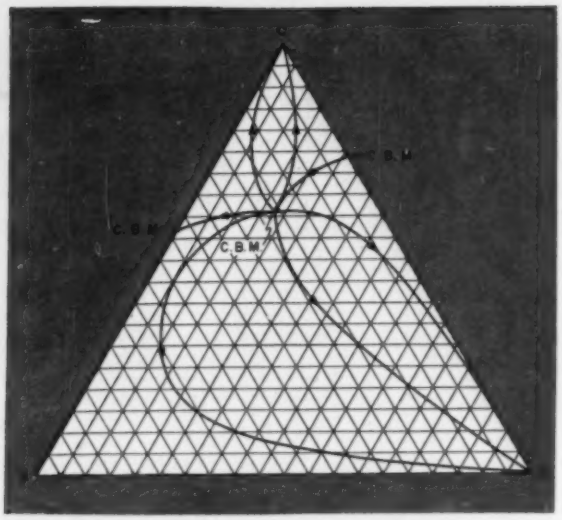


FIG. 14. Simple distillation curves, mixture corresponds to Fig. 8. Liquid compositions at constant pressure.

introduced at the top and heat applied at the bottom. The products are also continuously withdrawn. Large commercial units are of the continuous type.

If the change in composition of the liquid in the still during a simple distillation is plotted on the triangular diagrams, Fig. 11 through 14 result. The curves shown are drawn in only approximately correct as they were not calculated. These are the distillation curves as described by Schreinemakers.[4] A similar set of curves result from a partial condensation process when the curves represent the vapor condensation when the liquid formed on partial condensation is immediately withdrawn from the system. The arrows on the lines indicate the direction the liquid composition follows in a simple distillation process.

Distillation curves are very useful in helping to understand what separations are possible in abnormal systems.

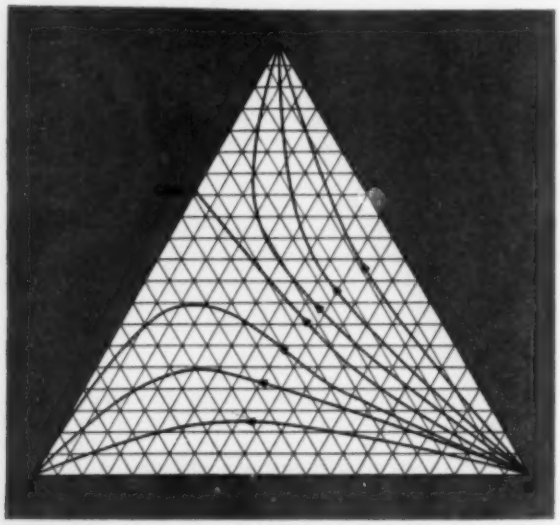


FIG. 13. Simple distillation curves, mixture corresponds to Fig. 6. Liquid compositions at constant pressure.

The concentration gradients in continuous distillation column will approximate these distillation curves. Fig. 11 indicates that it would be practically impossible to directly separate pure A from a ternary mixture since one would have to cross at right angles the distillation curves around A. In Fig. 13 the distillation line CBM — B divides the diagram into two separate regions. If the dividing line CBM-B is straight or nearly so, separations are impossible that require crossing of this line. If the liquid dividing line is sufficiently curved, it can be crossed to obtain a separation on both sides of the dividing line. This follows from the fact that for a straight liquid distillation line, the corresponding vapor distillation line coincides with it, while if it is curved, the vapor line falls on the convex side. Ewell and Welch[1] have reported a batch distillation where the boiling point of the material coming out actually dropped in temperature as is shown in Fig. 15. This occurred on crossing a curved dividing line. Simple distillation curves for a system with two binary azeotropes and one ternary are shown in Fig. 14.

COMPLEX MIXTURES

A complex mixture is one that has such a large number of components that individual components cannot be separated by ordinary distillation methods. Complex mixtures such as crude petroleum and its wide boiling range products, gasoline, kerosine, diesel fuel, etc. are characterized by laboratory distillation curves and tests. The usual laboratory distillations are described by Nelson.[2] They are:

a. **Engler or ASTM (ASTM test procedure).** The charge liquid is placed in a flask of a fixed size and heated at a prescribed rate, normally at atmospheric pressure. The vapors when formed are removed by condensation while the distilling temperature is read from a thermometer placed in the neck of the flask at the entrance to the condenser. The collected condensate is reported as volumetric percent recovered of the charge to the flask. Due to an unavoidable slight induced reflux in the top part of the flask, the temperature in the bottom of the flask is higher than the vapor temperature but is not reported.

b. **Hempel or true boiling point (TBP).** This distillation is similar to the Engler but employs reflux with a packed

IT'S NEWS! IT'S NI-O-NEL!

...a field-proven Inco Nickel Alloy for handling certain hot acids and oxidizing chemicals

Inco is now making available a field-proven alloy to handle corrosive conditions of unusual severity.

The alloy, called Ni-o-nel*, is made of Nickel (42%), chromium (21.5%), and iron (30%) with additions of molybdenum and copper. It is highly resistant to hot sulfuric, sulfurous and phosphoric acid conditions and to oxidizing conditions such as nitric acid solutions, nitrates and cupric, ferric and mercuric salts, except the chlorides.

Ni-o-nel alloy is stabilized by the addition of titanium and by its moderately low carbon content to prevent attack due to carbide precipitation.

In phosphoric acid:

1. Ni-o-nel alloy submerged cylinders and baffle plates in submerged combustion evaporators concentrating wet process phosphoric acid at temperatures up to 280°F, are giving 3 to 5 times the service life of previously-used materials.

2. In the dip pipes of units concentrating phosphoric acid by passing preheated air into the acid, Ni-o-nel alloy outlasted the previous alloy by 11 to 7.

3. In a defluorinating unit handling phosphoric acid of 54% P_2O_5 content, Ni-o-nel alloy lasted 2 to 6 times longer than the best previously-used alloy.

4. Ni-o-nel alloy can also be used in many similar applications such as hydrocarbon polymerization processes using phosphoric acid as catalyst, and for heating coils in the application of phosphate coatings to steel.

In sulfuric acid:

1. Platecoils of Ni-o-nel alloy have been used for heating a 12% (by wt.) sulfuric acid pickling bath maintained at 170°F. The platecoils lasted approximately 3 years (6 times longer than those of another resistant alloy).

2. Ni-o-nel alloy dancer roll arms in a continuous pickler used for processing steel strip in 8-12% sulfuric acid at 130°F temperature have so far lasted 17 months – 3 times longer than the previously-used alloy, and are still going strong. The Ni-o-nel alloy parts are subjected to considerable aeration as well as to the pickling solution itself.

In other corrosives:

1. Sulfurous acid. Ni-o-nel alloy has been shown to be superior to alloys customarily used to handle sulfurous acid in pulp and paper applications and in handling sulfurous combustion gases.

2. Nitric acid mixtures. Ni-o-nel alloy is resistant to nitric acid solutions of practically all temperatures and concentrations and shows good promise for handling such mixtures as nitric-sulfuric, nitric-phosphoric and some nitric-hydrofluoric acid solutions.

3. Organic acids. The alloy is resistant to most organic acids and has excellent resistance to boiling concentrated acetic acid, acetic-formic mixtures, maleic and phthalic acid and a number of others.

4. Sea water and chlorides. This alloy not only resists a wide range of chemical corrosives but also certain troublesome salt cooling waters, making it particularly adaptable for heat exchanger equipment. It resists pitting in salt water and has excellent resistance to stress-corrosion cracking.

*Registered trademark

Ni-o-nel alloy is a fully developed engineering material

Ni-o-nel alloy is made in all mill forms needed for fabricating process equipment... including welding electrodes. To get detailed information on this new engineering material, write for Inco's booklet, "Introduction to Ni-o-nel."

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N.Y.

INCO NICKEL ALLOYS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

For equipment
materials of construction
engineering services

chemical engineering catalog

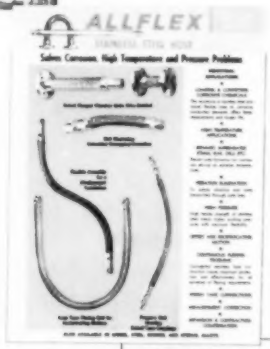
This up-to-date, completely indexed volume contains product data furnished by over 500 of America's leading manufacturers. **Represented here, for example, are some of the companies who participate in CEC** and help to make it your convenient year 'round reference source.

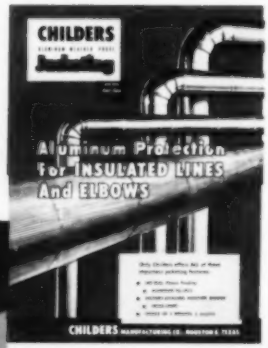
VIKING
Pump Company

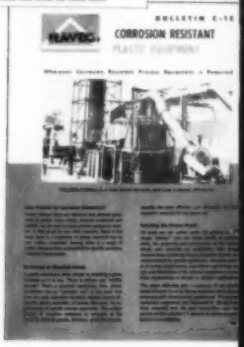
FALLS (FI) INDUSTRIES, INC.

Koven

ROOTS
SINCE 1854
CONNERSVILLE







CONSECO

One exclusive source of chemicals and raw materials information bound to serve your daily reference needs. Consult CMC often —it will serve you well with product data **furnished by leading companies similar to those shown on this page.**

cmc

CHEMICAL MATERIALS CATALOG AND DIRECTORY OF PRODUCERS

1958

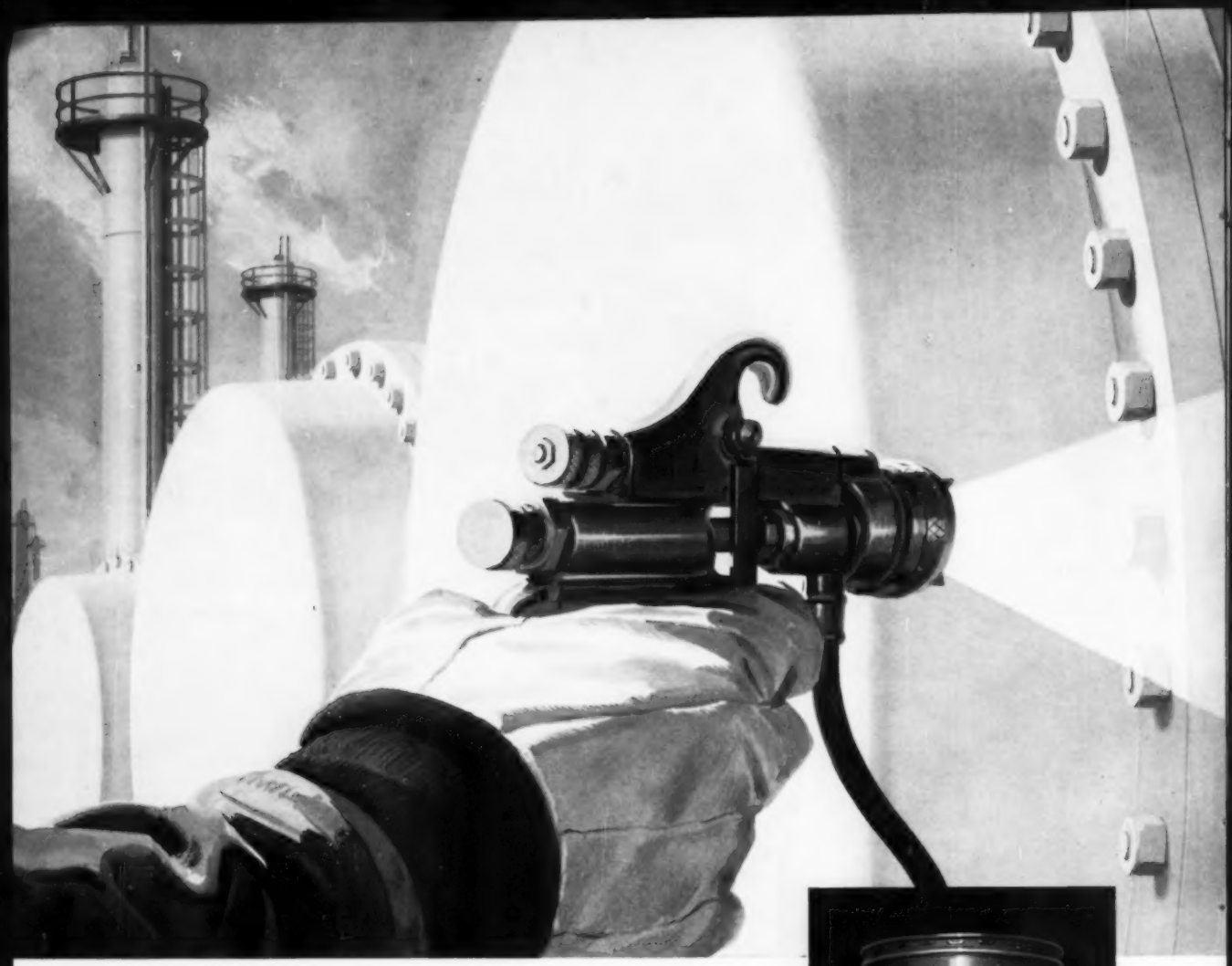
REINHOLD

chemical materials catalog

For Chemicals and Raw Materials

REINHOLD PUBLISHING CORPORATION

430 Park Avenue, New York 22, N.Y.



Humble Coatings Give You Three-Way Reduction in Maintenance Costs!

Humble coatings last six months to a year longer than most other paints. You save *two* ways — on paint and labor. The *third,* and most important, way you save is this: you get better protection, which means longer life for expensive equipment.

Humble coatings contain rust-preventing ingredients that not only provide surface protection, but also neutralize any corrosive elements that may penetrate the surface protection and attack the metal. These coatings were specially developed to give maximum protection in refineries and chemical plants where strong acids, alkalis and salt sprays produce severe corrosive conditions.

Without cost or obligation, one of Humble's trained engineers will make a thorough study of your needs and recommend a complete painting program for you. Call your nearest Humble representative, or phone or write:

HUMBLE OIL & REFINING COMPANY
Consumer Sales, P.O. Box 2180,
Houston 1, Texas

Humble's line of coatings includes —

- RUST-BAN ®
- Epoxies
- Phenolics
- Tank coatings
- Vinyls
- Acrylics
- Enamels
- Hot surface coatings
- Interior and exterior emulsion-type paints

HUMBLE

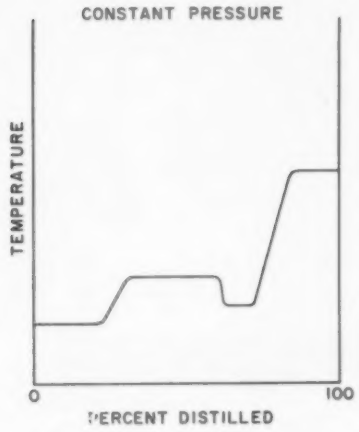


FIG. 15. Batch distillation curve.

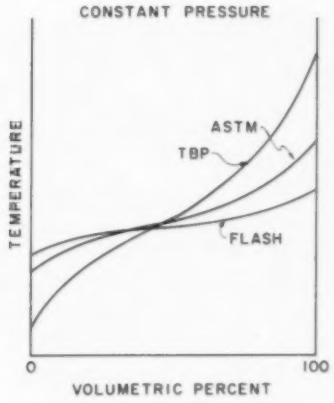


FIG. 16. Complex distillations.

fractionating column located between the flask and the condenser. An extremely high precision TBP distillation is called High Temperature Fractional Distillation or HTFD. It is carried out with 50 to 100 theoretical trays with reflux ratios of around 50:1. For light hydrocarbons refrigerated temperatures are used and this precision distillation is called Low Temperature Fractional Distillation or LTFD. Both of these latter distillations are capable of separating the lighter components and giving plateaus in the batch distillation curves for light naphthas. In general, for most of the hydrocarbon mixtures, even the precise distillations will give only smooth distillation curves and consequently, simpler and less precise TBP distillations are used in these cases. A TBP column of 20 theoretical trays with 20:1 reflux ratio is frequently used.

c. **Flash curve (Vapor-liquid equilibrium).** Flash or vapor-liquid equilibrium in complex mixtures is obtained from the flash curve which gives the percent vaporized (usually volumetric percentage) plotted against the temperature for a fixed pressure. This type of distillation is carried out in a continuous flash drum located in a constant temperature bath, with the evolved gas and liquid quantities being measured at various flashing temperatures. Atmospheric pressure and vacuum are usually used. The inside of the drum is designed for efficient separation of the vapor from liquid with a very low hold-up time.

A comparison of these distillations is shown in Fig. 16. If thermal breakdown occurs in the flask, these curves will become flat rather than concave upwards on the right side. Correlations are available in the literature to allow one to draw two of the above distillations from one laboratory obtained distillation. These correlations will be discussed with complex distillation.

Another method of analyzing complex mixtures is to measure physical properties of small increments of the condensate. These are called mid percent point curves. The physical constants frequently measured are gravities, viscosities, refractive indices, octane numbers, and these are plotted against the volume percent distilled.

One determination of some importance with flammable liquids is the open or closed cup flash point. It indicates the temperature at which enough vapor is generated above the pool of liquid to flash or explode. This flash point is about 200 to 220 F lower than the ASTM initial boiling point.

Another determination is the Reid vapor pressure which is measured by nearly filling a bomb with the material being tested. The gage pressure inside the bomb is then taken when the bomb is at 100 F. This reading is the Reid vapor pressure. Since there is always air in the bomb and some of the lighter constituents will boil out of the liquid being tested, the Reid vapor pressure is somewhat lower than the true vapor pressure. For narrow boiling range materials, say boiling within 100 F, the Reid vapor pressure is less than 1 psi lower. It also deviates more for the higher boiling materials.

It is fortunate that crude oil approximates a homologous series and no serious deviations from perfect liquids occur. Hence, the separation that is attained in these batch laboratory distillations are approximated in continuous fractionators. The critical point for these complex mixtures is shown on Fig. 10. When appreciable aromatics are present, which do azeotrope with aliphatic hydrocarbons, some discrepancies between the laboratory and commercial separations will occur.

MULTICOMPONENT SYSTEMS

A multicomponent system is one consisting of a number of identifiable components. At a given temperature and pressure there are C-1 degrees of freedom for a system of C components because the mole fraction of the C^{th} component may be obtained by difference from unity. As a result, on the two dimensions of a flat piece of paper equilibria for three components may be shown or, if a projection or contouring is allowed, four components might be covered. For a system with a large number of components, graphical representation of all compositions on the one curve is impossible and recourse is taken to algebraic relationships of the form $y = Kx$ where K is tabulated or plotted as a function of temperature and pressure, and sometimes an additional parameter is used. This is discussed later. The graphical representation of ternary and quaternary systems has been covered by Ricci.[3]

REFERENCES

1. Ewell, R. H., and Welch, L. M., *Ind. Eng. Chem.*, 37, 1224 (1945).
2. Nelson, W. L., *Petroleum Refinery Engineering*, 4th Ed., McGraw-Hill, New York (1958).
3. Ricci, J. E., *The Phase Rule and Heterogeneous Equilibrium*, Van Nostrand, New York (1951).
4. Schreinemakers, *F.A.H., Zeits. f. Physick, Chemie*, 36, 449 (1901).
5. Treybal, R. E., *Mass Transfer Operations*, McGraw-Hill, New York (1955).

★ ★ ★

The safest way in the world to compress inflammable gas

PROBLEM: To compress highly inflammable gaseous oxygen to 400 PSI by centrifugal compression without the inherent hazards of an oxygen-oil vapor mixture...explosion and product contamination.

CONVENTIONAL SOLUTION NO. 1: Separate oil vapors and process gas by pumping an inert buffer gas such as nitrogen into labyrinth strips between the gas and mechanical seals.

DISADVANTAGES: Buffer seal controls must operate correctly at all times. Supply of inert gas must be continuous. Product purity may be endangered. No positive seal during shutdown.

CONVENTIONAL SOLUTION NO. 2: Bleed process gas from the compressor through labyrinths in a direction opposed to the oil vapors.

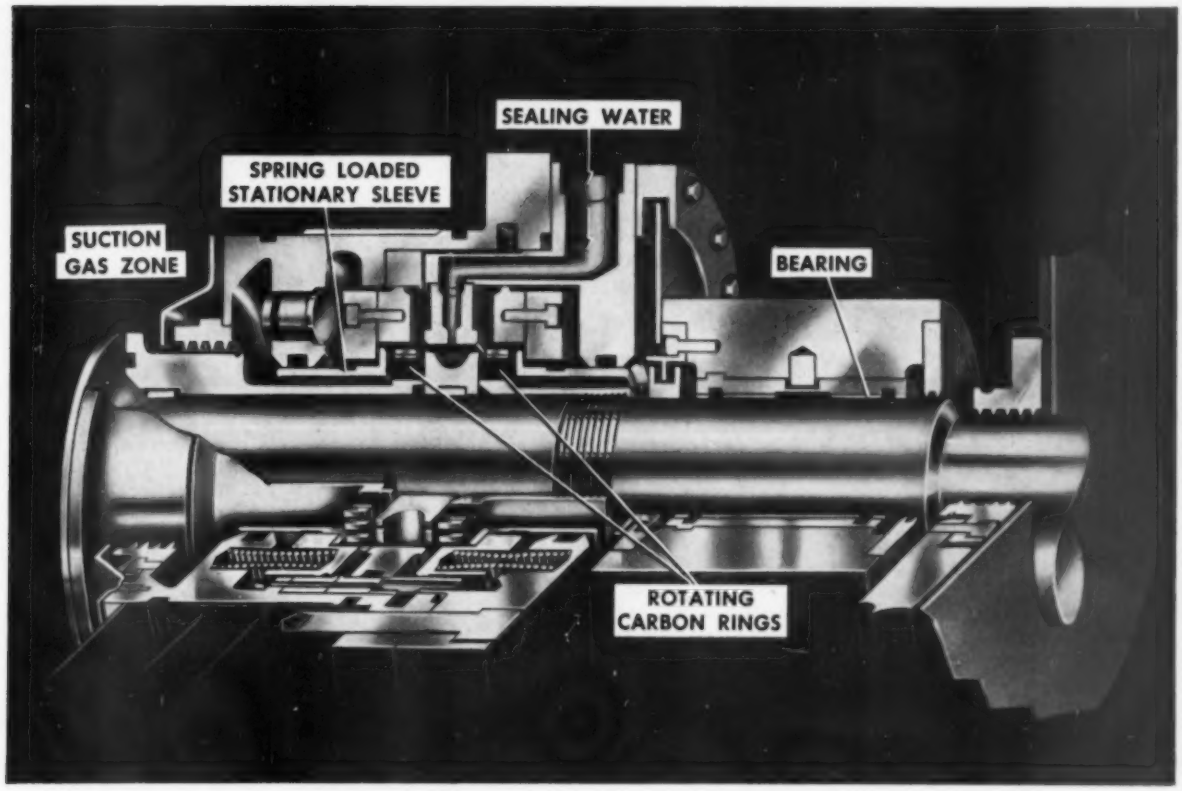
DISADVANTAGES: Creates dangerous oxygen-oil vapor mixtures in seal bleeding passages. Loss of product. And no positive seal during shutdown.

CARRIER SOLUTION: Install a Carrier Centrifugal Compressor with water-lubricated iso-carbon mechanical seals. Water is pumped between two rotating carbon rings placed back to back, acts as the lubricant and assures a positive seal of the oxygen from the bearings and atmosphere.

CARRIER ADVANTAGES: Positive seal both running and shut down with no hazardous oxygen-oil vapor mixture, loss of product or contamination. Sealing water controls need not be sensitive and compressor speed or pressures have no effect on seal performance.

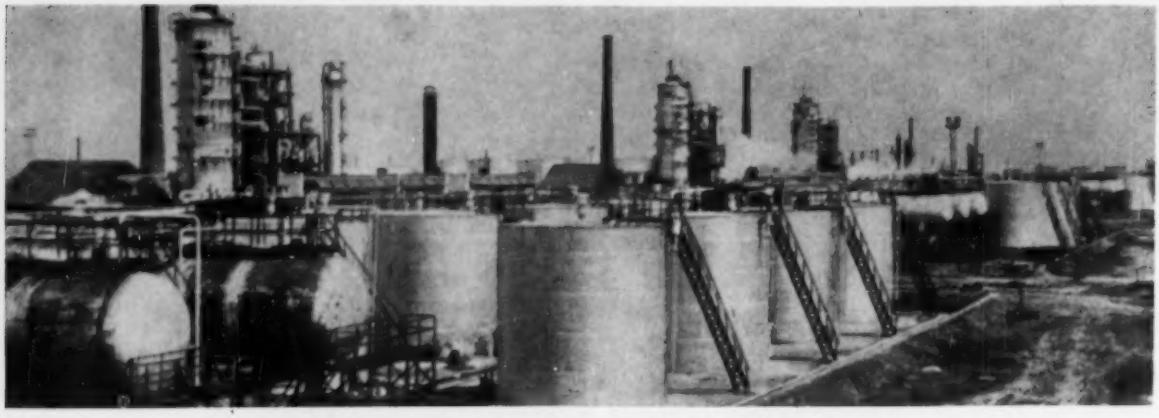
FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

WHAT IS YOUR PROBLEM? Carrier has the answer in a wide range of specially-designed compressor seals. For complete information, ask your nearest Carrier office for descriptive literature on "Centrifugal Compressor Seals" (18P117). Or you can write Carrier Corporation, Syracuse 1, New York.



Carrier

Refrigeration Gas Compressors



Expanding refinery at Omsk, first in Siberia. Began in 1950, the plant went into partial operation in 1955, and construction work is still in progress.

Russian Refining Emphasis Is On Growth . . .

New Seven-Year Plan poses threat to world markets, especially in the lower quality products

RUSSIA'S fast-rising crude production has brought growing pains to the Soviet refining industry. Outwardly, the USSR's petroleum processing setup looks healthy enough. It is not only meeting basic domestic needs but providing the products necessary for larger exports to both Communist bloc and free nations.

Moreover, while the American refining industry has slowed expansion of basic capacity, Russia is building new plants at a record rate.

Yet there are indications that the Russian refining industry has borrowed heavily from the future. It has increased basic capacity at the expense of downstream processes such as catalytic cracking and catalytic reforming. Many obsolete plants continue to operate full blast.

As a result, Soviet refinery technology lags well behind that of the West. Russia has become notorious for its low-quality automobile gasoline, diesel fuel and lubricants.

There is a real possibility that a serious gap between crude production and basic refining capacity will develop during the USSR's recently-launched Seven-Year Plan for Economic Development (1959-1965).

Despite sharply-increased appropriations for refinery construction and expansion during the past several years, Soviet refined products output is not keeping pace with crude deliveries. Work on several of the largest new Russian refineries is far behind schedule.

Refining output lagging. The USSR's State Planning Committee (Gosplan) reports that during 1958 crude production in the Russian Soviet Federated Socialist Republic rose 19 percent while refinery output went up only 16 percent. The RSFSR includes the "Second Baku" area between the Volga River and Ural Mountains, which has accounted for most of the Soviet Union's postwar oil production and refining capacity gains.

Capacity figures clouded. While the USSR in recent years has become reasonably free with its oil exploration, drilling, production and pipelining data, figures on refinery capacity, both for the nation as a whole and for individual plants, are shrouded in official secrecy. Much of the data provided is in the form of impressive-looking percentage gains.

Crude production boost. Russia plans to boost crude production from 113 million metric tons in 1958 to 230 to 240 million tons in 1965. During this period it hopes to raise "primary oil processing" capacity 110 to 120 percent, catalytic cracking capacity 330 percent, and catalytic reforming capacity "by 16 to 18 times."

Productive capacity for lubricants will double. Far more facilities are planned for petrochemical manufacture at new refineries.

If these objectives are achieved, Soviet penetration of the world petroleum products market will undoubtedly increase. Russia is already making fast progress in this field. In 1957, the USSR's oil products exports were for the first time valued at over a billion rubles. (Official value of the ruble is 25 cents. Actual value is placed as low as 10 cents.)

Russia increases exports. During 1957, latest year for which complete, official Soviet foreign trade statistics are available, Russia exported 58,000,000 bbl of oil products and 44,000,000 bbl of crude. This was a substantial increase over the USSR's 1956 exports of 46,000,000 bbl of oil products and 29,000,000 bbl of crude.

The nation-by-nation breakdown showed that Communist China was the largest buyer of Russian refined petroleum products in 1957. It imported 16,000,000 bbl during the year.

Other major purchasers of Soviet refinery products in 1957 were Finland 7,760,000 bbl, Egypt 5,620,000 bbl, West Germany 5,500,000 bbl, Poland 5,180,000 bbl, Sweden 4,000,000 bbl, Bulgaria 2,840,000 bbl, Greece 2,260,000 bbl, Iceland 2,240,000 bbl, France 1,710,000 bbl, North Korea 1,340,000 bbl, Algeria 1,240,000 bbl, Norway 1,100,000 bbl, Switzerland 963,000 bbl, Czechoslovakia 770,000 bbl, and Italy 566,000 bbl.

Russia's 1957 oil products imports totaled 21,900,000 bbl, down substantially from 28,300,000 bbl in 1956.

Assures Luxury Driving for CITIES SERVICE Customers

A new platinum catalyst reformer at its East Chicago, Ind. refinery now enables Cities Service to supply Midwest customers with a new gasoline for true luxury driving. Feeding on low octane gasoline distilled from crude oil, the reformer substantially increases the octane of the gasoline prior to blending with other refinery streams.

A key unit in the reformer is the large, modern debutanizer tower which Graver fabricated on order from Procon Incorporated, the prime contractor. Produced to API-ASME codes and spot X-rayed, the tower is 101′ tall, weighs 138,200 lbs. and is designed to operate at 350°F under 175 psig.

If there is a tower in your future plans, talk it over with Graver. Over 100 years of experience assure the skills and quality you seek.

GRAVER TANK & MFG. CO.
DIVISION—UNION TANK CAR COMPANY
EAST CHICAGO, IND.

GRAVER®

Plants and Offices Across America

"NOW

wait
a
minute...

Tell me why I can make any more money with Houdry's catalyst than with someone else's?"

Quite a challenge . . . coming from a chemical engineer who knows plant operations inside out. As prospective buyer of a catalyst, you'd probably ask the same question, yourself.

Well, here's the answer.

You may require a catalyst for any one of a number of specific processes. No matter where you buy it, its composition may be pretty much the same.

But composition does not prove its earning power. This is something that can be done only in your process, in your equipment, in your plant. And that is where the experience of your supplier counts.

You make a maximum return when your supplier understands your needs, and can make his catalyst deliver accordingly. Because we are process designers, creators of catalysts and catalytic processes, this is a job HOUDRY people know well.

When you buy catalyst from HOUDRY, you're buying all the benefits of pioneering experience in catalysis. Why not tell us your requirements, and let us give you a more detailed description of how we can serve you.

*

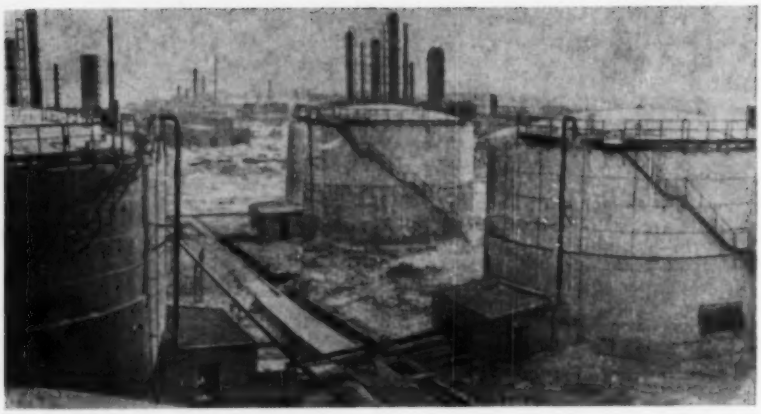
HOUDRY

CATALYSTS

HOUDRY PROCESS CORPORATION

1528 Walnut Street, Philadelphia 2, Pa.

*Houdry means Progress . . . through Catalysis



Angarsk refinery construction near Irkutsk in central Siberia will not be completed until the 1960s. The plant will be fed by Russia's longest crude pipeline orginating west of the Ural Mountains in Bashkiria's Tuimaza field.

Romania supplied 88 percent — 19,300,000 bbl—of the USSR's oil products imports during 1957.

Nearly 35 percent (20,180,000 bbl) of Russia's 1957 oil products exports consisted of diesel fuel; over 28 percent (16,350,000 bbl) was mazut (residual fuel oil); and 22 percent (12,700,000 bbl) was gasoline. Kerosine exports totaled 677,000 bbl and lubricants 1,510,000 bbl.

Quality to be improved. Soviet officials admit that much of the gasoline sold to satellite and other foreign customers was low in octane, while the diesel fuel frequently had high sulfur and paraffin content. They promise, however, that better-grade products will be available for foreign as well as domestic markets in future years with wider use of catalytic reforming, hydrofining and carbamide deparaffination.

Russia's State Scientific-Technical Committee says that part of Russia's current refining industry difficulties date back to the 1954-1955 period, when crude output began to soar at the same time that total capital outlays for new processing plants were temporarily cut back. Furthermore, the committee explains, that funds available "were spent mainly for urgently-needed primary processing facilities at the expense of construction on other technological installations, including thermocatalytic units — thermal cracking, catalytic cracking — and reforming, coking and isomerization.

"This, in turn, led to a second disproportion between quantity and quality of refined oil products. These disproportions must be eliminated as soon as possible, but at the same time it must not be thought that such problems can be solved in one or two years."

Technology and capacity — two pressing factors. Obviously Russia will be hard-pressed in merely keeping basic refinery capacity in line with crude production during the Seven-Year Plan, let alone improving quality. Throughput capacity must increase an average of 125 to 135 million bbl annually in the 1959 to 1965 period, compared with a required 106 million bbl annually between 1956 and 1958, and only 49.3 million bbl annually between 1951 and 1955.

Russia's Refineries

During the last several years Russia has placed large new refineries on stream at Omsk in western Siberia (1955), Stalingrad on the lower Volga River (1957), Gorky on the upper Volga River (1958), Perm on the Kama River (1958) and Fergana in eastern Uzbekistan (1959). All of these units except for Fergana are fed by pipeline from the prolific "Second Baku" fields.

The Volga-Ural area now processes over 50 percent of Russia's crude, compared with only 10 percent in 1940. By contrast, the Caucasus area, including famous old Baku, now has less than a third of the Soviet Union's refinery capacity against 84 percent in 1940.

Construction behind. Russia frankly admits that its refinery construction program is behind schedule, although products output has risen 250 percent in the postwar period. The Omsk, Novo-Gorky and Stalingrad plants all went on stream later than originally planned.

Current and planned units. Criticism has also been voiced over delays at the Ryazan refinery, which is still under construction southeast of Moscow, and at the Novo-Yaroslavl refinery being built at Yaroslavl on the upper Volga River northeast of Moscow. The Novo-Yaroslavl refinery, scheduled to go onstream in 1961, will

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

use "Second Baku" oil from Bashkiria and Tataria.

Promyshlenno - Ekonomicheskaya Gazeta (Industrial-Economic Gazette), official organ of the State Planning Committee, recently reported that preparations for building refineries at Polotsk in northern Byelorussia (White Russia) near the Latvian border and at Krasnoyarsk in central Siberia are lagging.

The Krasnoyarsk unit and another refinery now under construction at Angarsk, near Irkutsk on Lake Baikal, will be fed "Second Baku" crude by a new trans-Siberian pipeline. A 1200-mile pipeline will deliver Bashkir and Tatar oil to Polotsk in 1962 or 1963.

Cost and manpower problems. Soviet petroleum industry economists complain that capital expenditures on new refineries per additional bbl of products remain high despite improvements introduced since 1955. Number of operating personnel is also reported to be excessive because of insufficient automation and poor layout.

The State Planning Committee charges that "serious mistakes" made until recently in planning and building refineries included: "Providing new plants with installations having low productivity and with inefficient apparatus and equipment requiring excessive repair and servicing; using insufficient automation for measuring, for regulating storage, and for moving crude, semi-finished products and finished products within the plant; going to extremes in fire prevention by locating storage tanks and other plant units twice or three times as far apart as in similar foreign refineries; and employing too many steam-driven pumps instead of using surplus heat generated at the technological installations, thus requiring extra outlays for larger heating and power plants."

Program for expansion. Because of these shortcomings, a set of "basic regulations for planning oil refineries" was drawn up and applied to plants still in the early stages of construction. Resulting changes made in the Ryazan refinery project are expected to cut building costs 21.5 percent, reduce operating personnel 45 percent, and increase the quality of products.

Promyshlenno - Ekonomicheskaya Gazeta has disclosed that it requires 10 years to put a projected large-capacity refinery onstream. This period includes two to three years for drawing up plans and seven years for actual construction.

The State Planning Committee suggested that construction time for refineries with a capacity of 44,800,000 bbl annually could be cut from seven years to four years or less if three or four standardized plans were pre-

WE DELIVER

We know you have money in mind when you talk about buying catalysts.

We know you think of profit, as well as price. We certainly agree that there may not be much difference, pricewise or otherwise, between one company's catalyst and another's. But there *is* a difference in what you get when you buy it. And when *this* difference shows, it shows in your profits.

That's why—when you are considering the purchase of one of our catalysts—we make our experience in industry and in pioneering and perfecting catalysts and catalytic processes available to you. You have our full assistance in selecting the *one* catalyst from our many grades which will make the *most money* for you.

And when you select a catalyst we manufacture, we evaluate its performance and offer our application knowledge to see that it is *delivering what you want* . . . maximum efficiency, maximum profit.

*HOUDRY PROCESS CORPORATION
1528 Walnut Street, Philadelphia 2, Pa.
*Houdry means Progress . . . through Catalysis

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD C-67

pared. Under this setup, equipment, buildings and storage tanks would not only be standardized but delivered to the construction site in preassembled sections insofar as possible.

Even the construction organizations working on the refineries, their equipment, supply bases, garages and repair shops, would be standardized and designed for easy dismantling and movement from one site to another.

Refineries with 44,800,000 bbl per year capacity appear to be the largest plants currently being built or planned in the USSR. Besides three atmospheric vacuum distillation units of 44,800,000 bbl total annual capacity, standardized refineries in this category have two units each for catalytic cracking (12,700,000 bbl total capacity annually), catalytic reforming (7,454,000 bbl), and "light cracking to lower boiler oil viscosity" (12,700,000 bbl).

Russia's Refining Future

Looking to the future, Russia's State Scientific-Technical Committee believes that important savings could be achieved if highly-automated refineries with 90 to 135 million bbl capacity per year "and perhaps even more in certain cases" were built at strategic locations. "These refineries must consist of two or three independently-operating blocks of 44,800,000 bbl capacity each, with enlarged and combined installations in each block.

Economy in larger plants. "Studies show that savings in capital outlay per ton of refined oil come to 16 percent when the plant's capacity is doubled. If at the same time the plant's various installations are enlarged, savings can reach 25 percent.

"This, of course, does not overlook the fact that it will also be advisable to build smaller-capacity plants in some districts. But such refineries will be the exception."

Taking as an example three atmospheric vacuum installations of 4.4, 7.454 and 15.0 million bbl annual capacity, the Scientific-Technical Committee gives these cost estimates "based on our present level of metallurgical, machine-building and automation development": 4.4 million-bbl unit: Capital outlay 11,485,000 rubles or 19.1 rubles per 7.454 bbl of annual capacity; operational expense 7,844,000 rubles or 13.1 rubles per 7.454-bbl of refined oil. (Official value of the ruble is 25 cents; actual value is placed as low as 10 cents.)

7,454,000-bbl unit: Capital outlay 17,867,000 rubles or 17.9 rubles per 7.454 bbl of annual capacity; operational expense 12,611,000 rubles or 13.98 rubles per 7.454 bbl of refined oil.

Fifteen million-bbl unit: Capital outlay 19,217,000 rubles or 9.6 rubles per 7.454 bbl of annual capacity; operational expense 17,588,000 rubles or 10.65 rubles per 7.454 bbl of refined oil.

Stalingrad refinery on the lower Volga River went on stream in 1957.

Russia began putting 15 million bbl per year primary processing units in operation at its largest new refineries last year. Refineries built previously had 3.5 to 4.5 million bbl per year units.

Combined units for future. The Scientific-Technical Committee emphasized that larger-capacity plants are not the only way to achieve greater refinery efficiency. It said much more attention must be given to combining now-separate installations and multi-stage processes within each plant.

"Doubts or excessive caution must not weaken our efforts with regard to building reliable and technically-improved combined installations. We must recruit more specialists so that after activating a few combined installations in the near future we later will be prepared for their mass introduction.

"However, we cannot tolerate a situation whereby the amount of equipment, its height and diameter are increased to provide better productivity. We must design and build more efficiently-operating furnaces, columns and other apparatus and equipment with the thought in mind that higher productivity can be achieved with the same dimensions."

The Scientific-Technical Committee contends that "introduction of combined installations will enable us to reach and surpass the level of technology and efficiency achieved in the United States." But it concedes that Russian industry is not now prepared to supply both twice as much and better equipment for the larger refineries proposed under the Seven-Year Plan. It said several more machine-building plants must be assigned to fulfillment of the refining industry's specialized requirements.

Sulfur content serious crude problem. Another major problem confronting the Soviet refining industry is the high sulfur content of petroleum found in Russia's most important new producing areas.

Next year, over 60 percent of the oil delivered to Russian refineries will come from "Second Baku" fields in Tataria, Bashkiria and Kuibyshev Province alone. Crude from these districts as well as from nearby Stalingrad and Saratov Provinces and from the Uzbek, Kirghiz and Tadjik Soviet Socialist Republics in Central Asia is high in sulfur.

On the other hand, the old Baku and Grozny fields, whose relative importance is declining sharply, produce low-sulfur, low-resin, lower-paraffin crude.

According to Soviet classifications, oil is considered "sulfurous" if the sulfur content is 0.5 to 1.9 percent. "Highly-sulfurous" Russian crudes are those with sulfur contents above 1.9 percent.

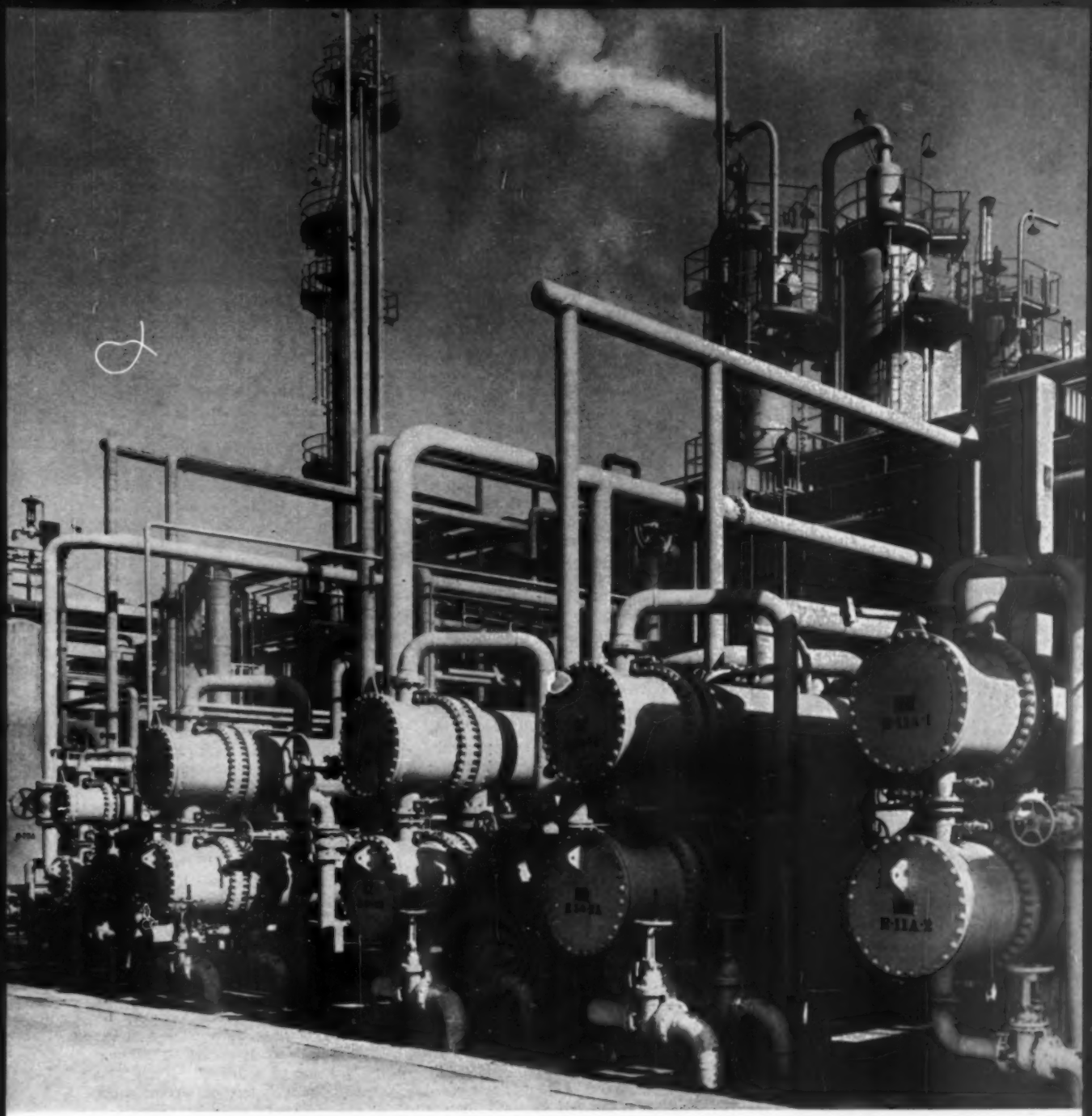
In "Second Baku" fields, the sulfur content averages 1.4 to 2 percent and reaches 6 percent. Resinous matter ranges from 20 to 40 percent and averages 36 to 40 percent in Tataria, Bashkiria and Kuibyshev Province.

Paraffin content is also high — 5 to 6 percent. Salt content is as much as 5000 to 6000 milligrams per liter.

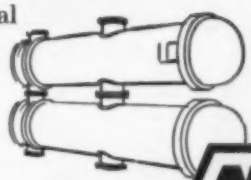
Cost to process sulfur crudes. Official Russian data show that capital expenditures for new refineries designed to process sulfurous crude are 50 to 100 percent more (depending on the type of plant) than capital outlays for refineries using low-sulfur crude. Capital expenditures for plants processing high-sulfur (above 1.9 percent) crude are 40 to 50 percent higher than for similar installations using sulfurous crude.

Much the same situation prevails in operating Soviet refineries. It costs 110 to 200 percent more to run a high-sulfur plant than a low-sulfur unit of the same capacity since processing of sulfurous crude causes corrosion and faster breakdown of equipment.

To combat the effects of sulfurous oil in Russian refineries, more corrosion-resisting alloy steels and anti-corrosion coatings are being employed, together with better reagents to neutral-



ON STREAM, ON TIME... these Kellogg heat exchangers, fabricated in the company's Jersey City shops, are just a few of the thousands Kellogg has put into service for leading petroleum refiners and chemical companies throughout the world. Stacked-unit fabrication techniques in the plant assure alignment and cut erection time in the field. For prompt deliveries plus design and engineering excellence at optimum cost, call Kellogg's Fabricated Products Sales Division.



THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N.Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York
Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

M KELLOGG W

THREAD LEAK REPAIR
—QUICK, FINAL!

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.

SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U.S.A.

for **leakproof, pressure-tight connections**

use TiteSeal®

SEALING COMPOUNDS

Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

7 BASIC BLENDS

LIQUID WRENCH®
The super-penetrating rust solvent

LOOSENS
rusted bolts, nuts, screws, 'frozen' parts

Liquid Wrench works *fast*... yet is absolutely safe for all metals and alloys.

2171

At Industrial, Automotive, Hardware, Plumbing Jobbers

RADIATOR SPECIALTY CO.
Charlotte, North Carolina

GOLDEN SEAL

ize and depress active corrosive products contained in the crude.

Other processing problems. Also troubling the Russian refining industry, according to the magazine *Neftyanoe Khoziaistvo* (Oil Economy) are the improper procedures still being employed to stabilize, dehydrate and desalt crude. Blame for instituting the "erroneous crude preparation practices" is placed on the USSR Ministry of the Oil Industry, which was abolished several years ago.

"The present setup, whereby dehydration is done at the fields, desalting at the refineries, and, generally speaking, stabilization of crude isn't done at all, is harmful and must be quickly corrected," *Neftyanoe Khoziaistvo* declared. "It is necessary that dehydration, desalting and stabilization of crude take place at the producing locations or at other points before the oil enters the main pipelines."

Neftyanoe Khoziaistvo suggested that "in order to conserve capital outlays for refineries over the near term, high-sulfur crude should be processed by a simplified system — obtaining a minimum quantity of light oils and a maximum quantity of furnace oils. An exception can be made for an installation having surplus hydrogenation capacity." The publication said that crude must be carefully graded to prevent high-sulfur types from reaching refineries unprepared to process it.

Need for motor fuel small. Russia, unlike the U. S., does not require enormous amounts of automobile gasoline, although consumption is rising steadily. The USSR has only one car for every 61 persons compared to one for every 2.6 persons in the U. S.

Last year Russian passenger car production was only 122,000. In 1957 it was still less — 113,600, compared with 6,120,000 built in the U. S. the same year.

By contrast, the USSR built 389,000 trucks and buses in 1958 and 381,900 in 1957. (Comparable figures for the U. S. were 872,000 and 1,100,000.) Many Soviet trucks are diesel powered, while others run on compressed natural gas or LPG.

Russian crude characteristics. "Second Baku" crude, upon which Russia is increasingly dependent, contains 22 to 25 percent gasoline fractions boiling at up to 200 C; 23.5 to 24.5 percent diesel fractions, and 21.5 to 25 percent distillates boiling at 350 to 500 C which can be used for catalytic cracking or for making oils and paraffin.

Straight run gasoline fractions from "Second Baku" crude are characterized by low octane numbers — from 42 to 47. Diesel fuels have good octane numbers (from 50 to 55) but also have high solidification temperatures (about minus 10 C) and contain 0.9 to 1.2 percent sulfur (sometimes as much as 2 percent), resulting in increased engine wear.

Promise of higher octanes. Compression ratios for engines in Russia's newest cars are considerably higher than for Soviet automobile engines produced several years ago but are well below ratios for late American cars. With top-quality Soviet automobile gasoline still in the 70 to 75 octane range, high engine compression ratios must await the 87 to 90 octane gasoline promised later in the Seven-Year Plan when more catalytic cracking, reforming and hydrofining capacity will be available.

Russian officials concede that low octane gasoline has cost the nation hundreds of millions of rubles annually in added operating expense. They agree that "slightly greater capital investment in facilities producing higher-octane motor fuel would pay for itself within a year."

Diesel fuel. Importance of diesel fuel has grown rapidly in recent years, constituting about 37 percent of Russia's light oil output in 1958. This proportion is to continue rising, and diesel fuel is expected to be the main product of Soviet refineries during the next 10 years.

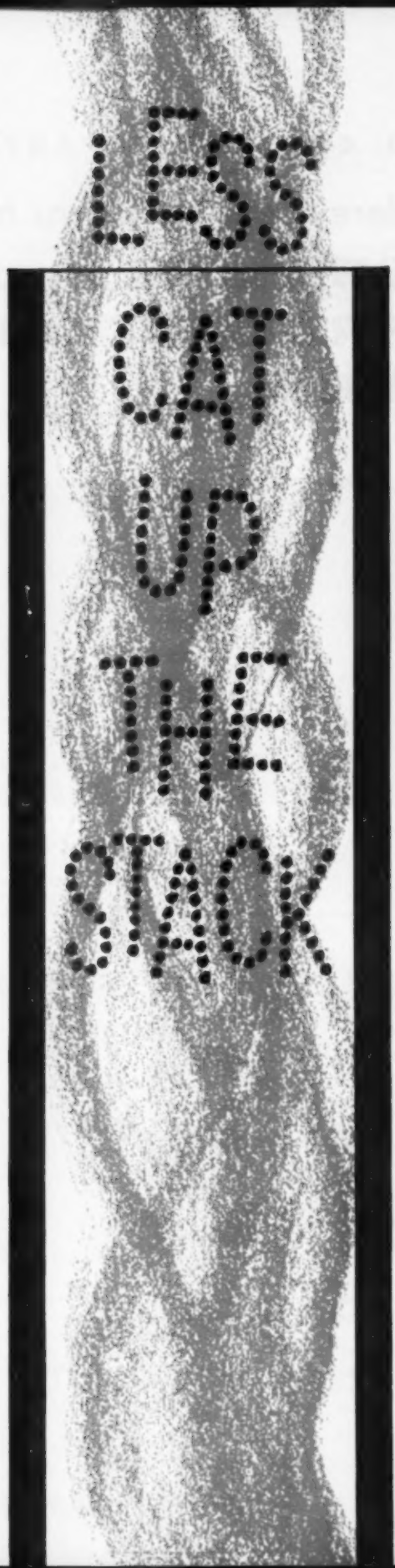
Need for jet fuel soaring. Demands for aviation fuel used in turboprop and turbojet engines is soaring spectacularly. (By 1965, last year of the Seven-Year Plan, 90 to 95 percent of the ton miles flown by the Russian civil airline will be with jet and turboprop planes.)

Tractor fuel. It's a different picture with tractor kerosine, which as recently as 1956 constituted one-third of all Russian light oil production. By last year, with the Soviet switch to diesel tractors, the proportion of kerosine had plummeted to 4 percent.

The State Scientific-Technical Committee says greater attention must be given to the use of gas turbine engine fuels for surface transportation, "since the wide use of such fuel can radically change the technological arrangement of our refineries."

Soviet to use U. S. developments. While conceding that the Soviet refining industry (with its emphasis on diesel fuel rather than automobile gasoline) will develop differently from that in the U. S., the State Scientific-Technical Committee warned that "this does not mean we must not use the very rich experience of the United States in oil processing.

"In our opinion, it is especially beneficial to follow (American) practice in the construction and operation of large refineries, particularly plants with increased capacity for thermocatalytic processes." ★ ★ ★



with Davison Catalysts

Your stack carries away regeneration gases —not catalyst—when you put Davison in your unit. Here's why:

With Davison Catalysts you get the lowest amount of unretainable fines.

With Davison Catalysts you get lower attrition. The lower breakdown rate of Davison Catalysts means you get the fines you need without light particles escaping up the stack.

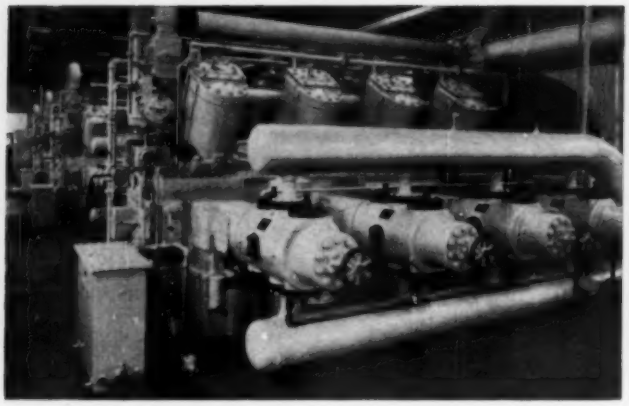
The reason: *balanced density*. There's a Davison Catalyst to suit your application. Write Department 4213, today for Product Service Bulletin No. 59-101.

W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
BALTIMORE 3, MARYLAND

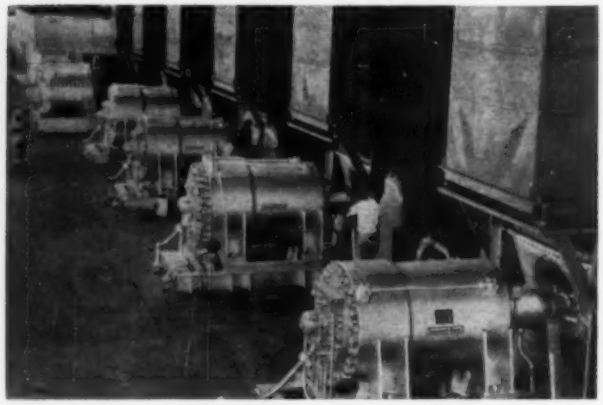
Behind this symbol ... a century of service

Here's what it means to

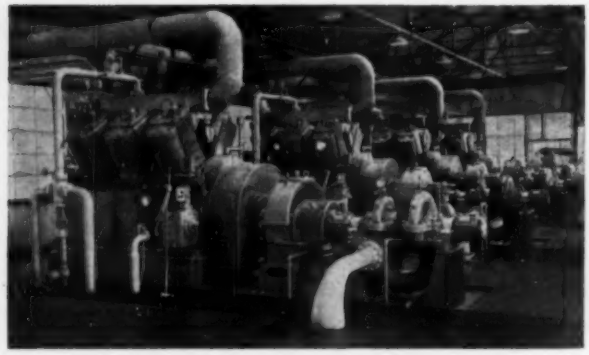
DRILLING and PRODUCTION MEN...



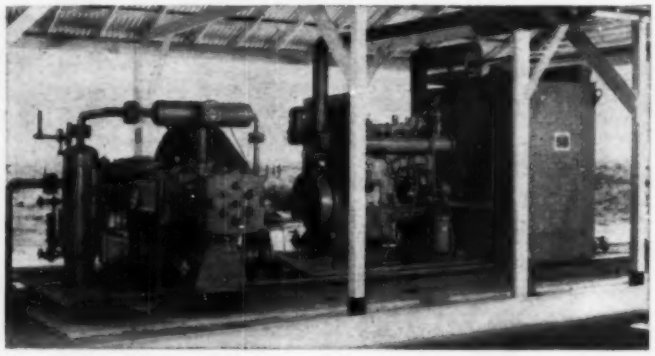
Ingersoll-Rand builds 4-cycle V-angle engine-compressors from 120 to 2000 hp and larger, for all field and production services. Their smooth, long-run operation through a wide range of loads and speeds makes them especially suitable for production services. Above are four 440-hp SVG gas-engine compressors operating at 700 psi on a southwestern gas gathering system.



Large volumes of gas for repressuring and conservation can often be handled to best advantage by Ingersoll-Rand centrifugal compressors. Units are available for any desired capacity, pressure, and type of drive. Above are 12 gas-turbine-driven I-R units, injecting up to 300,000,000 cfd of gas at 1800 psi to increase oil recovery and conserve gas.



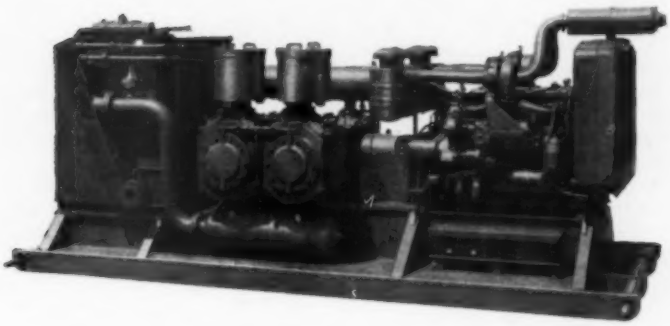
Here are four Ingersoll-Rand multi-stage centrifugal water injection pumps driven by 408-hp Ingersoll-Rand PSVG gas engines on a water flooding project. I-R centrifugal pumps are built in sizes and capacities to meet all process and natural gasoline plant requirements, and for water flooding, water supply and cooling water services. The 4-cycle V-angle engines range from 200 to 2000 hp and larger, for any prime mover application.



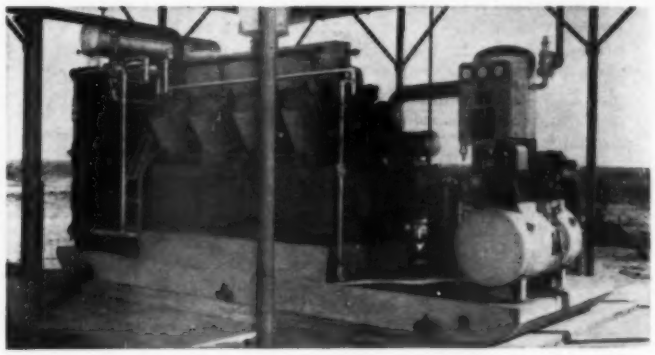
Ingersoll-Rand builds many types of compressors for gas lift, gas gathering, and other services that require tough heavy-duty units which can be moved from one location to another. Shown above is a 160-hp horizontal ESH compressor, skid-mounted with engine, cooler, and accessories. At right is a 240-hp JVG gas-engine compressor, "packaged" with cooler, starting-air compressor, and other auxiliaries.

to the oil industry:

Soon after Colonel Drake discovered oil at Titusville, the history of Ingersoll-Rand began with the manufacture of Cameron reciprocating steam pumps. A few years later, other I-R "ancestor" companies began building compressors and rock drills. Ever since that time Ingersoll-Rand has been growing with the oil and gas industries. Today I-R provides the widest range of compressors, pumps and other equipment for the production, transmission, and processing of oil and gas and their products—the I-R monogram is more than ever a symbol of leadership and progress.



Shown above is a completely self-contained Ingersoll-Rand skid-mounted compressor plant designed especially for air drilling. These rugged new packaged units include continuous-duty I-R two-stage balanced-design compressor, diesel or gas-engine drivers, and combination forced-air cooler all on one highway-width steel skid. In operation they are completely automatic and self-protecting—maintenance is minimized.



I-R MILESTONES OF PROGRESS
have had a far-reaching effect on the petroleum industry

1860 The first Cameron pump—a reciprocating steam pump which found wide use in the petroleum industry.

1871 Simon Ingersoll's steam-powered rock drill.

1872 Heavy-duty reciprocating compressors.

1902 The first portable compressor.

1906 The first direct-connected synchronous-motor-driven compressor.

1912 First centrifugal compressor for 90-psi air, and powered by I-R turbine.

1913 Centrifugal pump.

1920 Oil-engine compressor engineered as a unit; solid fuel injection.

1924 Large 4500-psi compressors for ammonia synthesis (still operating).

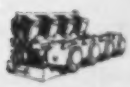
1927 Centrifugal pipeline pump; mechanical shaft seal.

1928 Barrel-type hot-oil charging pump for refineries.

1930 First compressor for 15,000 psi on commercial scale.

1931 Close-coupled Motorpump.

1931 First centrifugal gas pipeline compressor, "canned" with 3000-hp motor.



1933 Famous XVG gas-engine compressors combined multiple power cylinders and compressor cylinders on single frame.

1933 First non-lubricated compressors.

1935 Channel Valves set new standards for compressor valving, unmatched to this day.

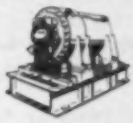
1937 Complete line of vertically-split centrifugal process pumps.

1940 First fluid cat-cracker main air blower.

1947 First high-pressure centrifugal compressor for gas transmission

1949 First centrifugal gas compressor for cat-cracking.

1952 First turbo-charged gas-engine compressor, the 2000-hp KVS.



1954 First centrifugal compressor for 2000 psi.

1955 Compressor built for 35,000 psi on commercial scale.

1958 Highest-pressure centrifugal pump —6500 psi.

Ingersoll-Rand

14-881 11 Broadway, New York 4, N. Y.

In engineered products, there's no substitute for experience

REFINERY CONSTRUCTION MANUAL

PART 10: Shop Fabrication—Steelwork

Henry Martyn Noel, *New Canaan, Connecticut*

FOR THE AVERAGE REFINERY, about $500 per bbl per day of capacity is spent for materials and equipment delivered to the site in various stages of prefabrication. Most of this cost lies in steel and steel equipment.

Steel consumption for refinery construction has increased greatly since 1930, as illustrated by Table 1. This increase for both process and offsite facilities is due to increasing complexity of modern refinery operations, but now there is an opposite tendency to reduce steel requirements by simplifying and enlarging process units.

A breakdown of steel tonnages for three cat crackers, in the recent records, is shown in Table 2.

Steel for process units arrives at the construction site almost entirely shop fabricated. Vessels that are of a size allowing rail or water shipment are completely shop fabricated. Larger vessels may be assembled and welded to the extent of 80 to 90 percent, but the plates and parts are all shop fabricated.

Tanks

From 20 percent to 30 percent of the steel for an average refinery arrives at the site in the form of cut, bevelled and rolled tank plates. Manholes and nozzles are ready to be welded on and the holes for them are already cut in most cases. Internal supports and floating roofs are completely fabricated.

Assuming 60 days storage (based on crude input) for crude oil, intermediate and final products and shipping, the total tankage for a 100,000 bbl per day refinery would be 6,000,000 bbl. Steel requirements for tanks are from 7 lb per bbl storage capacity for large tanks (50,000 to 100,000 bbl), to 9 lb per bbl for medium tanks (10,000 to 20,000 bbl), to 10 to 20 lb per bbl for small tanks (1000 to 10,000 bbl). An average figure is 8 lb per bbl for the entire refinery, meaning 24,000 tons of steel for the complete 100,000 bbl per day refinery tank needs, or about 0.24 tons per bbl of capacity.

Shop fabrication is the least part of the cost of tanks. Delivery time for the total refinery tankage, erected in the field, may be 6 to 14 months after the order is placed. Of this period, only 2 to 4 months would be for actual shop work, the rest being waiting time and field erection. Delivery of steel plate from the steel mills to the fabricating shop may take 2 to 4 months, and field erection may take 2 to 6 months.

Standard tanks, conforming to API standards, require almost no new drafting work, and the bills of material can be duplicated from tank to tank. The shell normally consists of 8-ft by 30-ft plates with thicknesses of ¼ in. for the top course to 1⅛ in. for the bottom course of large tanks.

Labor for tank fabrication, excluding floating roofs, is about 4 percent as manhours based on the unerected tank costs in dollars. Large tanks of about 100,000 bbl capacity, and costing about $60,000 F.O.B., would use about 2000 manhours of shop fabrication time.

Vessels and Tubulars

The term "vessels" includes everything from simple small receiving drums and side stream strippers to fractionating columns, flash drums, reactors, catalyst hoppers, regenerators, and gas separators.

Fractionating towers, including internals, are fabricated and usually assembled before shipment, unless the size requires shipment in parts for field assembly and welding. The shells are made by one manufacturer and the internals, of alloy steel, by another.

Normal delivery time for a large, complicated tower, which must be fabricated step by step, and field assembled, can require 5 to 14 months. Small, shop assembled pressure vessels require slightly less time, 4 to 8 months.

Preparation of shop drawings for a large fractionating tower consumes 4 to 6 weeks, depending upon how much detail is supplied to the fabricator by the client. In general, they give a picture of the complete assembly, show all overall dimensions, give sketches of all important details, and give bills of materials so that plates may be cut and parts completely specified for ordering.

Steel plates and structural shapes are ordered as soon as the shop drawing listing is far enough along. There should normally be a delay of only three months after the order is placed before actual shop fabrication starts.

In the lead time for large fractionating towers, one month may be used in preliminaries and waiting for materials, and one month for inspection and preparation for shipment. Actual fabrication requires 3 to 4 months, but conflicting schedules may increase it to six months.

Smaller vessels and heat exchangers require only 4 to 8 months total as much of the required material is apt to be on hand at the shop, and the shop drawings are more or less standard.

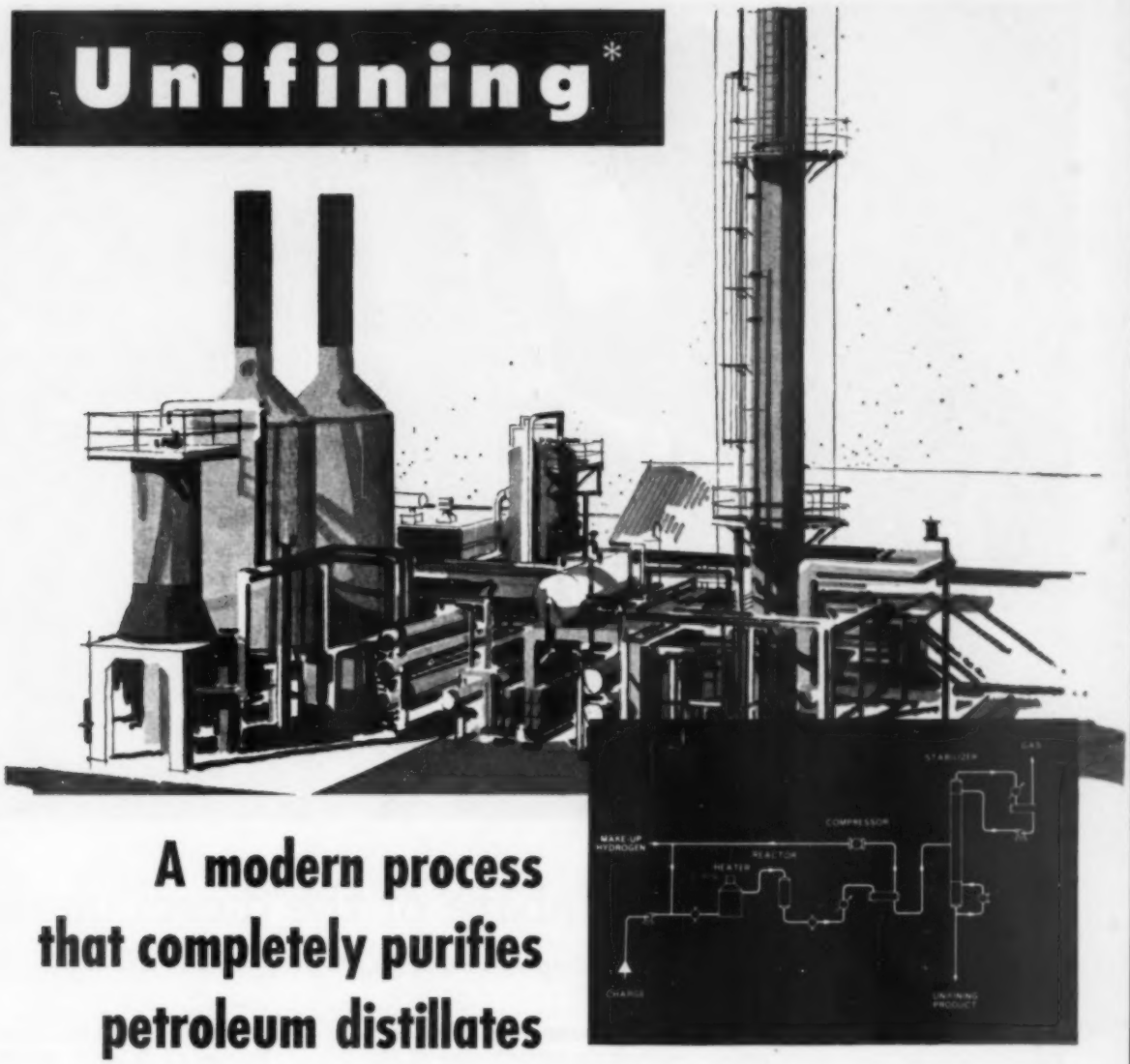
About 70 percent of the cost of building towers and exchangers lies in the material, and 30 percent in the labor. Some typical examples of fabrication times for exchangers and towers are shown in Table 3.

Structural Steel

Structural steel accounts for about 25 percent of the steel within battery limits in a refinery and about 10 percent of that for offsite facilities. It arrives at the construction site entirely cut to size, punched, fitted with clip angles, and partly assembled — it is entirely fabricated.

This structural steel comprises the supports, platforms and bracing for all vessels, piping, tubulars, buildings frames and furnaces, etc.

Unifining*



A modern process that completely purifies petroleum distillates

Here is an efficient and economical answer to an operating problem that often proves costly and difficult to solve. An uncomplicated and easily operated process, Unifining eliminates sulfur, nitrogen and metallic impurities from petroleum distillates, and prepares feed stock of ideal properties for further processing.

In the Unifining process, simultaneous saturation of olefins also occurs, producing ideal virgin-like products that make further processing easier, or give greater stability to fuel oils.

This process works particularly well in combination with Platforming®. It is ideal for pretreating Platformer feed stocks, and the excess hydrogen from the Platformer constitutes a low-cost hydrogen supply for the Unifining unit. For long, durable operation Unifining uses an exceptionally rugged catalyst called Hydrobon®, manufactured by Universal.

Developed by Universal Oil Products Company in conjunction with Union Oil Company of California, Unifining is available through UOP to all refiners.

*Trademark

UOP®

UNIVERSAL OIL PRODUCTS COMPANY

30 Algonquin Road, Des Plaines, Illinois, U.S.A.

More Than Forty Years Of Leadership In Petroleum Refining Technology

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

How to get a bigger share of the diesel market

Formulate superior diesel fuels using DuPont FOA-2 to reduce filter plugging

When you add Du Pont Fuel Oil Additive No. 2 to your lower grade stocks, you cut down the rate of sludge formation and greatly improve the fuel.

This is because FOA-2 is an excellent dispersant and solubilizer. It reduces the size of insoluble residue particles. The tiny particles can then flow through the system and burn with the oil. Consequently, filter-clogging and injector-sticking are greatly reduced.

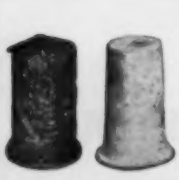
Performance tests have demonstrated the effectiveness of FOA-2. For example, in one test with a heavy cycle stock treated with FOA-2, the engines ran for 35 days without changing filters and without appreciable pressure drop. Without FOA-2, the filters became blocked in one week.

FOA-2 not only cuts sludge formation, it often cleans parts where sludge has begun to build up.

Being ashless, FOA-2 does not contribute to exhaust stack sparking.

Because of its many outstanding advantages, Du Pont FOA-2 is now being widely and successfully used by many oil companies in the diesel fuels supplied to the nation's leading railroads.

Your Du Pont representative can fill you in with further details. Or you can write for more information to E. I. du Pont de Nemours & Co. (Inc.), Petroleum Chemicals Division, Wilmington 98, Delaware.



Better filterability of FOA-2 treated fuel is shown here. The filter at the left was clogged in a week's use of untreated economy fuel. The clean filter at the right was used several weeks in an economy fuel with FOA-2 added.

DU PONT

Better Things for Better Living
. . . through Chemistry

Tetraethyl Lead
and other
Petroleum Additives

Table 1. Tons of Metal Required for a Complete 100,000 bbl per day Refinery in Different Years.

	(Number) & Total Cap. of Units, b/d			Carbon Steel used, tons				Alloy Steel used, tons				Copper and Admiralty used, tons				Total Metal used, tons			
	1930[1]	1940[2]	1945[3]	1951[4]	1930[1]	1940[2]	1945[3]	1951[4]	1930[1]	1940[2]	1945[3]	1951[4]	1930[1]	1940[2]	1945[3]	1951[4]	1930[1]	1940[2]	1945[3]	1951[4]
Shell still batteries	80,000[1]	—	—	—	5,190	—	—	—	—	—	—	—	175	—	—	—	5,365	—	—	—
Pipe stills	20,000[2]	100,000[2]	100,000[4]	100,000[4]	735	9,415	9,415	9,415	29	580	580	580	99	255	255	255	863	10,250	10,250	10,250
Vacuum stills	—	10,000[1]	30,000[2]	30,000[2]	—	1,074	2,397	2,397	—	108	283	283	—	68	160	160	—	1,250	2,840	2,840
Thermal crackers	30,000[6]	40,000[1]	5,000[1]	5,000[1]	6,150	5,500	943	933	875	800	170	180	225	200	37	38	7,250	6,500	1,150	1,151
Catalytic crackers	—	10,000[2]	45,000[3]	50,000[2]	—	4,717	8,962	19,850	—	82	351	570	—	126	338	730	—	4,925	9,651	21,150
Thermal reformers	13,500[3]	15,000[2]	7,500[1]	—	2,914	3,941	1,723	—	—	—	135	—	61	84	42	—	2,975	4,025	1,900	—
Catalytic reformers	—	—	7,000[1]	19,000[2]	—	—	8,037	11,848	—	—	313	483	—	—	75	155	—	—	8,425	12,476
Naphtha feed prep	—	—	7,500[1]	25,000[3]	—	—	1,105	1,506	—	—	—	75	—	—	45	69	—	—	1,150	1,650
Gasoline clay treaters	15,000[2]	20,000[4]	—	—	338	420	—	—	—	—	—	—	12	15	—	—	350	435	—	—
Gasoline sweetening	27,000[2]	30,000[3]	40,000[1]	40,000[4]	1,397	1,106	1,436	1,436	—	—	—	—	24	19	25	25	1,421	1,125	1,461	1,461
Isomerization	—	—	2,500[1]	2,500[1]	—	—	404	404	—	—	7	7	—	—	12	12	—	—	423	423
Alkylation	—	—	3,000[1]	8,000[2]	—	—	4,110	4,605	—	—	37	42	—	—	144	163	—	—	4,291	4,810
Polymerization	—	3,000[2]	1,000[1]	—	—	4,878	1,976	—	—	10	5	—	—	112	50	—	—	5,000	2,031	—
Gas treating	—	6,000[2]	2,000[1]	—	—	4,878	1,976	—	—	10	5	—	—	112	50	—	—	5,000	2,031	—
Lube plant[5]	1,500[1]	3,000[1]	3,500[1]	4,000[1]	2,204	1,050	1,050	1,050	7	10	10	10	38	66	66	66	2,249	1,126	1,126	1,126
Acid plant (tons/day cap.)	—	—	150[1]	200[1,6]	—	—	2,420	2,857	—	—	300	350	—	—	100	118	—	—	2,820	3,325
Total for process units					18,928	32,101	43,978	56,291	911	1,580	2191	2580	634	945	1349	1701	20,473	34,636	47,518	60,662
Total for offsite facilities					39,650	67,500	75,300	95,050	—	—	—	—	350	500	700	950	40,000	68,000	76,000	96,000
Grand total metal requirement					58,578	99,601	119,278	151,341	911	1580	2191	2580	984	1445	2049	2741	60,473	102,636	123,518	156,662
Tons/bbl per day of metal—process and offsite					0.59	1.00	1.19	1.51	0.01	0.02	0.02	0.03	0.01	0.01	0.02	0.03	0.60	1.03	1.23	1.57

[1]Complete, sweet crude refinery, 100,000 bbl per day, built in 1930. [2]Complete, sweet crude refinery, 100,000 bbl per day, built in 1940. [3]Complete, partly sour crude refinery, 100,000 bbl per day, built in 1945. [4]Complete, sour crude refinery, 100,000 bbl per day, built in 1951. [5]1930 unit includes acid treat, clay treat, centrifugation and rerun. Other years include deasphalting, solvent extraction, dewaxing and clay treat. [6]Capacity in tons/day.

Table 2. Breakdown of Steel Tonnages for Three Typical Cat Crackers.

	13,500 b/d Cat Cracker #1		15,500 b/d Cat Cracker #2		15,500 b/d Cat Cracker #3	
Where steel used	Tons	%(Unit)	Tons	%(Unit)	Tons	%(Unit)
Furnaces	328	10.3	550	9.3	605	9.3
Tubulars	183	5.8	439	7.4	329	5.1
Vessels	827	26.1	1508	25.4	1650	25.3
Structural	844	26.6	1197	20.1	1447	22.2
Piping	799	25.2	1534	25.8	1566	24.1
Miscellaneous	189	6.0	711	12.0	915	14.0
Total (unit)	3170	100.0	5939	100.0	6512	100.0
Excess for buildings	—	—	2900	—	—	—
Grand total	—	—	8839	—	—	—

Table 3. Typical Fabrication Times for Exchangers and Towers.

	Medium, standard heat exchangers		Small, simple towers		Large, complex towers	
	Months	Man-hours	Months	Man-hours	Months	Man-hours
Engineer, schedule, order	½	50	½	75	1	250
Awaiting materials	½–1½	—	½–1½	—	3–4	—
Plate planing, rolling and rigging	1 wk	30	1 wk	70	2 wk	275
Welding of shell	1 wk	100	2 wk	175	4 wk	500
Heat treating	30 hr	30	½ wk	30	1 wk	70
Tube rolling	1 wk	100	—	—	—	—
Heads or tube sheet fabrication	1 wk	140	—	—	—	—
Baffle or tray fabrication	—	—	—	—	2 wk	250
Setup and welding—ext. and int.	—	—	1 wk	150	4 wk	430
Assembling	1 wk	120	½ wk	50	1 wk	—
Testing and shipping	1 wk	80	—	25	—	—
Total fabrication time	1	600	1	500	3–4	1600
Grand total time	2–3	650	2–3	575	4–5	1850

Normal procedure in ordering fabricated structural steel, after the completion of process and mechanical designs and the preparation of requisitions by the procurement engineers, is to have the purchasing department solicit bids.

About one month is needed before quotations are received, and another month before they are analyzed and the order placed. The successful bidder then issues shop orders to his shop and the job is put on the shop schedule and shop drawings made.

The shop drawings are then submitted to the client for his information in designing foundations, pipe connections, etc., but shop work is not delayed awaiting the clients approval. When competitive bids are not required, the fabricator can be advised of a forthcoming order even before the engineering work is complete. This permits the shop to schedule work as much as two months earlier than would be the case otherwise.

Structural steel in refinery construction amounts to less than 10 percent of the total cost of materials. A delivery time of six months for fabricated steel costing the refinery $100,000 involves an actual working period in the shop of about two months with an average force on the job of 20 men.

Piping

About 25 percent of the total refinery steel is in piping which is often prefabricated — cut to size, bent and flanged or bevelled for welding, etc. In some cases, it is preferable to fabricate the piping in the field using portable machines to bevel pipe ends and holes. The main advantages of shop fabrication are superior handling facilities and working conditions, as well as the use of heavier tools and more effective heating equipment. ★ ★ ★

SELECTIVE' SERVICE: aromatics to aspirin

Benzene and Toluene currently produced at Cosden Petroleum Corporation's Big Spring, Texas refinery, so greatly exceed the purity requirements of the ASTM "Nitration Grade" specifications, that these products are now being used directly in the manufacture of pharmaceuticals such as aspirin and cortisone.

As integral parts of the UOP Rexforming® and Udex® units at Big Spring, Western heat exchangers perform an important service in the conservation and transfer of heat during the selective extraction of these aromatic hydrocarbons.

Heat Transfer requirements for petrochemical processes present a worthwhile challenge, and Western will continue to expand its sphere of influence in the petroleum industry's growing importance to chemical consumers.

WESTERN
HEAT EXCHANGERS
WESTERN SUPPLY COMPANY
P.O. Box 1888 – Tulsa, Oklahoma

Refining Notables

W. F. Lowe

▸ **The Hanlon Award,** highest honor in the natural gasoline industry and one of the ranking awards in the petroleum industry, has been conferred on **William F. Lowe,** executive director of the Natural Gasoline Association of America. Lowe is the 23rd recipient of the award which is conferred annually by the NGAA for outstanding service to the gas processing industry. Donor of the award is **E. I. Hanlon,** board chairman of the National Bank of Tulsa and a pioneer in the natural gasoline business.

The citation read: "... this man has been the catalyst and guiding force behind all NGAA activities during the last 25 years." Lowe is a native of Benton Harbor, Michigan, and holds a degree in geology from the University of Michigan. After oilfield duty in Wyoming with Midwest Refining Company and as geologic scout in the Texas Panhandle with Midwest Exploration Company, he became technical editor for National Petroleum News and International Petrol-Technology. In 1934, he was named secretary of the NGAA, and was made executive director in 1957. Lowe has represented the association and the gas liquids industry in practically every national organization that has a bearing on natural gas products. His long and intimate connection with all phases of the industry and the Association has earned for Lowe the title of "Mr. Natural Gasoline".

Refining Personals

▸ The retirement of **Fred A. Davies,** board of directors chairman for Arabian American Oil Co., brought to a close an active association with Middle East petroleum which spans nearly three decades. Davies had also served as Aramco's chief executive officer, vice president in charge of exploration and production and executive vice president.

▸ Moving to Mexico City as manager of Mexican operations for National Aluminate Corp., is **Francisco (Frank) Chairez,** former chief chemist with Eastern States Petroleum and Chemical Corp.

▸ Election of **Winfield Givens** as executive vice president and **H. J. Meeks** as vice president of each of Sun Oil Co's eight foreign production subsidiaries has been announced.

LENAPE *Elliptical Manhole*

SADDLES or RINGS and FITTINGS

for Every Pressure Vessel Requirement

Lenape elliptical access openings (straight rings or flued and curved saddles) and fittings are produced in sizes ranging from 4" x 6" to 18" x 24".

Available in many materials

- **Code quality Carbon Steel**
- **304L and 316L Stainless Steel**
- **Everdur 1010 Silicon Bronze**
- **T-1 quenched and tempered steel**
- **also Monel, Nickel and Aluminum**

Low Cost • assured by Lenape's specialized production methods . . . savings which are passed on to you.

For detailed specifications write today for Bulletin 565 or refer to pages 44-48 in Lenape Catalog 10-53.

See our standard line of pressure vessel connections on pages 1128-1129 in the 1958 Chemical Engineering Catalog.

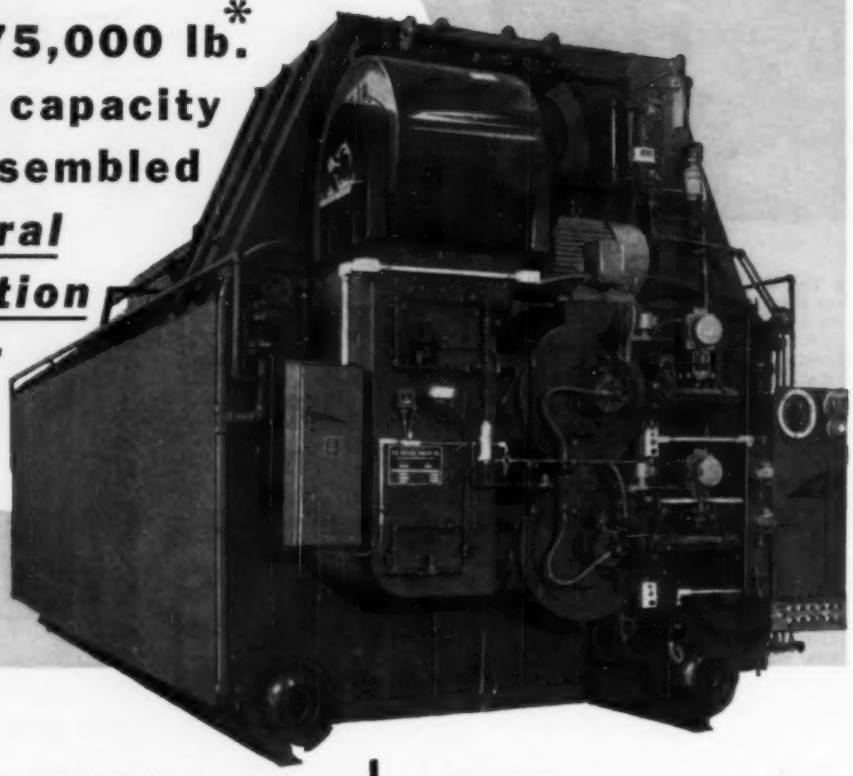
LENAPE PRESSURE VESSEL CONNECTIONS

LENAPE HYDRAULIC PRESSING & FORGING CO.
DEPT. 119 WEST CHESTER, PA.
RED MAN PRODUCTS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

...now from WICKES

a new 75,000 lb.* per hour capacity shop-assembled *natural circulation* boiler



*75,000 lbs. per hour present capacity.
80,000 lbs. per hour future capacity with economizer

Wickes Type A units are of simple design, ruggedly constructed and adaptable to a variety of operating conditions and may be Oil or Gas Fired.

All units are shipped completely shop-assembled including superheater fuel burning equipment, safety and combustion controls, forced draft fan and drive, soot blowers and feedwater regulator.

Save on

- **First Cost**
- **Operating Expense**
- **Space**
- **Delivery Time**
- **Installation Time**

For more detailed information on Wickes Type-A steam boilers, write for our catalog 56-1. Bulletin 55-1 covers the complete line of Wickes Products and Facilities.

WICKES typeA

WICKES

WICKES BOILER CO., SAGINAW 14, MICHIGAN
DIVISION OF THE WICKES CORPORATION

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Boston • Chicago • Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tulsa.

169

C. E. Webber

D. B. Edwards

J. M. Kindle

M. R. Lents

R. W. Heath

▸ **Charles E. Webber,** technical advisor to the vice president of Sun Oil Co., Philadelphia, was elected president of the Natural Gasoline Association of America at its 38th annual convention in Dallas. Vice presidents elected for 1959-60 are: **Donald B. Edwards,** Pan American Petroleum Corp., Tulsa; **John M. Kindle,** Lone Star Gas and Lone Star Producing Co.; Dallas; **Max R. Lents,** the Reef Corp., Houston; and **R. W. Heath,** Signal Oil & Gas Co., Los Angeles.

▸ Petro-Tex Chemical Corp. of Houston has announced the election of **Sydney T. Ellis** as president. Ellis was formerly executive vice president of Commercial Solvents Corp.

▸ Recent appointments made by Shell Development Co., Emeryville, Calif. are: **Dr. E. A. Youngman** is a research supervisor in the synthetic rubber department and **Dr. H. A. Kingsley** has been named a supervisor in the chemical process engineering department.

▸ Maintenance superintendent of SunOlin Chemical Co.'s Urea plant now under construction will be **Eugene T. Dotts.** Until completion of the plant, he will serve as field coordinator of construction for SunOlin.

▸ New engineering associates at Esso Research and Engineering Co. are **Dr. Harvey E. W. Burnside** of Locust, N. J., and **William P. Drews** of Westfield, N. J. Dr. Burnside is a member of the firm's petroleum development division, and Drews will continue his work in applied mathematics and operations research.

William E. McTurk, former assistant director of public relations, has begun a rotational assignment as assistant director of employee relations.

▸ **H. F. Shea,** Ponca City, Oklahoma, has been promoted to director of Continental Oil Company's manufacturing accounting division. Formerly assistant director of manufacturing accounting, he will continue to make his headquarters at Ponca City and will succeed the late C. M. Rowell.

▸ Assuming duties at his Caracas headquarters is **Hamilton P. Caldwell** who was named to the newly created position of manager of manufacturing in Mobil Oil de Venezuela. **Joe E. Penick,** formerly manager of the East Providence, R. I., refinery, succeeded Caldwell as manager of Mobil Oil Company's Augusta, Kan., plant. **David Christison** was named to succeed Penick in East Providence.

▸ **Kenneth E. Montague** has been named petroleum engineering counselor for Sun Oil Company's Domestic Production Department. He will serve all of the company's domestic producing divisions in the United States and Canada from his headquarters in Beaumont, Texas.

▸ Newly promoted assistant director of manufacturing accounting for Continental Oil Co. is **Phil H. Deschner,** Houston. The former assistant to the controller succeeds **H. F. Shea,** who recently was promoted to director of Conoco's manufacturing accounting division.

▸ **John R. Sabina** has been named manager of the tetraethyl lead and planning section of the DuPont Company's Petroleum Chemicals Division, succeeding **T. Baldwin Prickett** who retired March 31 after a 33-year career in the petroleum industry.

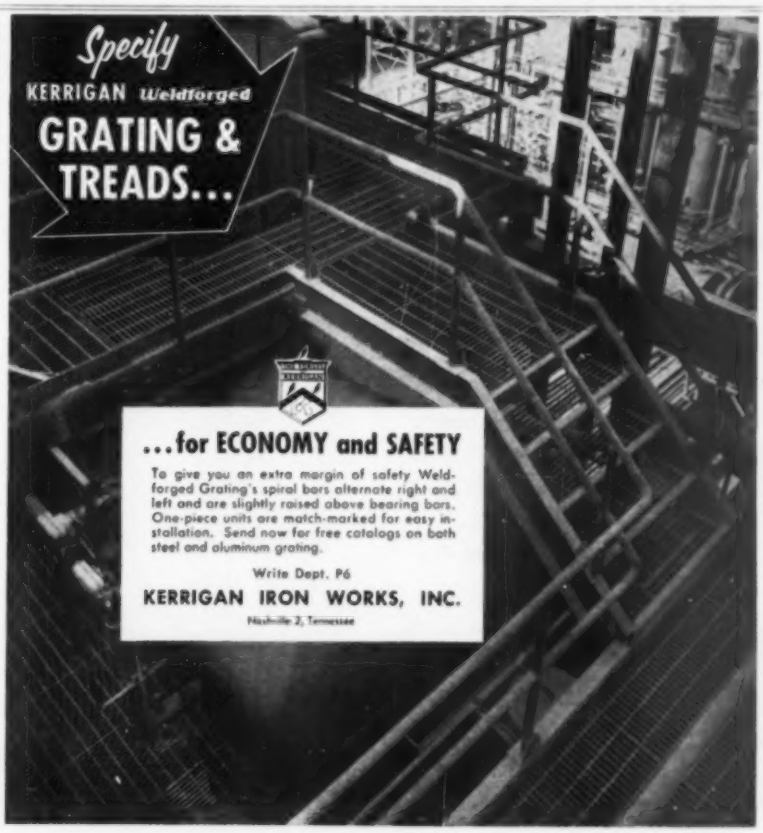
▸ **Dr. Lauchlin M. Currie,** prominent for his activities in the nuclear energy field both in U. S. Government and industrial circles, was elected this year to membership on Babcock & Wilcox's board of directors. He was elected a vice president in 1958 and was placed in charge of the company's Atomic Energy division. Dr. Currie attended the first "Atoms for Peace" conference in Geneva, Switzerland, in 1955 as a member of both the U. S. delegation and the U. N. Secretariat.

Dr. L. M. Currie

P. A. Blasco

▸ **Peter A. Blasco,** former general manager of refining, Aurora Gasoline Co., has been named vice president of manufacturing, the Vickers Petroleum Co., Inc., Wichita, Kan. Blasco succeeds **A. M. "Bob" Schrepfer,** who retired from the post January 1.

▸ **Charles M. Doscher,** head of chemicals sales for The Dow Chemical Company's New York office since 1956, has been promoted to the newly created position of sales manager of chemicals for the Dow international companies. **Frank H. Sellars,** of the Dow Atlanta office, has been advanced to succeed Doscher at New York.


Specify
KERRIGAN Weldforged
GRATING & TREADS...
...for ECONOMY and SAFETY
To give you an extra margin of safety Weldforged Grating's spiral bars alternate right and left and are slightly raised above bearing bars. One-piece units are match-marked for easy installation. Send now for free catalogs on both steel and aluminum grating.
Write Dept. P6
KERRIGAN IRON WORKS, INC.
Nashville 2, Tennessee

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

For a VARIETY of SIZES

in ALUMINUM CHLORIDE

make yours SOLVAY

You get a choice of screen sizes to fit your needs – plus uniformity, quality, purity, dependability, service – when you specify SOLVAY Aluminum Chloride.

Write for literature, prices, specific information.

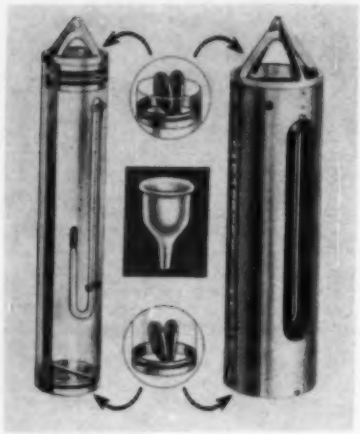
Allied Chemical

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N.Y.

Branch Sales Offices: Boston • Charlotte • Chicago Cincinnati • Cleveland • Detroit • Houston New Orleans • New York • Philadelphia Pittsburgh • St. Louis • Syracuse

Refining-Processing Equipment

For Complete Information on Items Described Here, Use Enclosed Reply Card.



Sampling Bob

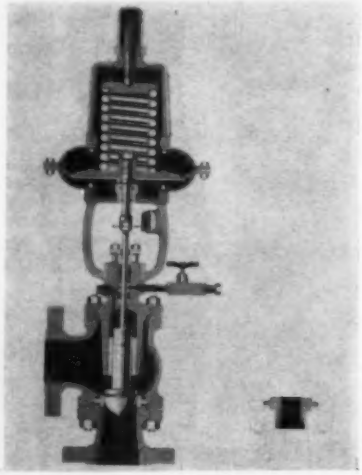
Sensitive butterfly wing valves at both ends of a new sampling bob permit accurate, undisturbed samples to be taken of liquids held in bulk storage, barge or marine tanks, from any level. Increased accuracy of octane and volatility analyses can be obtained, with samples protected from air or other outside contamination by the bob's construction. *Oreco Division of The Johnston & Jennings Company.*

Circle number (41) on reply card.

High-Capacity Trays

Flexitrays, which make possible use of smaller and lighter weight towers, have been developed for distillation, absorption, and stripping. Trays are streamlined and contain no stagnant areas in which foreign material can collect. New bulletin is illustrated with performance curves for these trays in service. *Koch Engineering Company, Inc.*

Circle number (42) on reply card.



Feedwater Regulator

Three-Way feedwater heater bypass valves are described in a new bulletin by *Schutte and Koerting Company.* The valves are designed for two-position operation, to effectively and economically direct water flow to, or bypass around, the feedwater heater. Their employment reduces requirements for fittings and fabrication.

Circle number (43) on reply card.

Acid-Resistant Mortar

Synar, an improved silica mortar, is being added to its list of products by *Pennsalt Chemicals Corporation.* Based on an aqueous colloidal suspension of silica, the new product is an inorganic, acid-resistant mortar, used in the construction of masonry linings in acid containers of many kinds—storage tanks, concentrators and absorbers—as well as in stacks and chemical process vessels.

Circle number (44) on reply card.

Drip Feeder

For use where drip feeding is required under high pressure, for corrosive conditions, for temperature conditions from below zero to 750 F, or as a small indicator is the new high-pressure drip sight feeder produced by *Jerguson Gage & Valve Company.*

Circle number (45) on reply card.

Improved Valve

A pneumatically operated angle-control valve, with an improved venturi effect designed to reduce turbulence and cavitation in control of slurries, viscous or flashing fluids is now available from *Minneapolis-Honeywell Regulator Company.* Valves are made of carbon steel and 316 stainless steel in sizes from 1 through 6 in., body ratings to 600 lbs.

Circle number (46) on reply card.

Control Valves

Designated as Series LM valves and featuring a single-seated valve body with extra thick body walls, a new line of handwheel operated control valves is now available from *Conoflow Corporation*. The valve is especially suited to solve corrosion and erosion problems encountered when using "hard-to-handle" process fluids.

Circle number (47) on reply card.

Plastic Strainers

Entirely of polyvinyl chloride construction, a complete line of plastic strainers is now available from *Vanton Pump & Equipment Corporation, division of Cooper Alloy Corporation*. Housing, strainer and gasket of the new units are constructed entirely of PVC, and are designed to trap particles hazardous to internal moving parts of process equipment.

Circle number (48) on reply card.

Model 816 Valve

High-pressure needle valves designed for pneumatic and hydraulic systems utilize renewable glass filled teflons, set for bubble tight shut-off with fluids from vacuum to 6000 psi. Fabricated by *Dragon Engineering Company*, the 816 can be mounted in seconds, and can be completely overhauled without removing it from the line. The stainless steel valves are available in standard ports, female NPT or female tubing AND 10050. Special ports can be obtained.

Circle number (49) on reply card.

Thickness Tester

Including batteries, probe, harness, cable and earphones, the new ultrasonic gage developed by *Branson Instruments, Inc.* weighs less than 5 lb, making it the smallest ever built. Completely self-contained, the Audigage Model 6 is used for nondestructive thickness measurement of most metals, glass, ceramics and plastics from one side.

Circle number (50) on reply card.

Chart Dial

New chart drive allows instant dialing of six different chart speeds without stopping the chart. Can be field mounted directly on change gear hubs, requiring no previous experience, no recorder modification and no special tools. *Insco Company, division of Barry Controls Inc.*

Circle number (51) on reply card.

Vacu Rule

A handy slide rule for setting up a high vacuum system has been developed by *Central Scientific Company*. The device saves time in calculating required pumping speed for any vacuum system, thus aiding the engineer in selecting the best pump to use for evacuating a system of given capacity. One dollar plus postage will bring you this handy slide rule.

Circle number (52) on reply card.

Gate Valves

Pressure sealing gate valves that provide a tight seal both up and downstream and require no lubrication, have been introduced to the petroleum industry by the *W-K-M division of ACF Industries, Inc.* The valves are available in the ASA 150 and 300 lb class in sizes from 2 to 12 in.

Circle number (53) on reply card.

"O" Ring

Properties of a KEL-F "O" ring with silicone rubber core permit operations under the following conditions of service: extreme chemical resistance, low coefficient of friction, good thermal characteristics, good resistance to extrusion, low compression set. *Fluro-Plastics, Inc.*

Circle number (54) on reply card.

Portable Welder

In less than one minute, a 4½ in. diameter standard pipe can be butt-welded with the new automatic welder by *Aluminium Ltd.* Sizes weigh from 40 to 50 lb. To make a joint, the unit is held by a strap clamp and the welding gun and cable drum gear travel around the horizontal axis of the pipe.

Circle number (55) on reply card.

Heat Exchangers

Coil type heat exchangers, manufactured by *Q.V.F. Ltd., of England*, are now being sold in the United States through *Corning Glass Works*. The compact, modular units are composed of a glass shell surrounding a single glass tubing coil which can be easily joined to standard American equipment.

Circle number (56) on reply card.

Metal-Pipe Cutter

Costing about one-tenth that of large machinery, a new tool, OR-O-CO, is being manufactured to cut precision holes and various shapes in thick metal plate. It attaches to any acetylene cutting torch to cut holes through metal walls and decks for pipe and electrical conduit. *Ideas, Inc.*

Circle number (57) on reply card.

Pipe Fittings

Malleable iron or aluminum pipe fittings are now available lined with Plastisol, in elbows, tees, reducing tees, reducers, caps and adapter nipples in sizes from 1¼ in. through 12 in. diameters. Announced by *Victaulic Company of America*.

Circle number (58) on reply card.

Foamed Plastic Insulation

The first pre-molded rigid polyurethane pipe insulating material is said to have greater thermal efficiency than any low-temperature insulation now on the market. The new material was specifically designed for low temperature application down to —300 F. It resists damage in handling, application and service because of its great compressive strength. *Baldwin-Hill Company*.

Circle number (59) on reply card.

Heat-Les Dryers

Operating and delivering air at a dewpoint below —200 F, the new Heat-Les dryer is believed to provide the lowest dewpoint ever achieved by a commercially available desiccant type dryer. Units are available in size ranges from compact, wall-mounted dryers for small flows to floor models handling compressed gases at thousands of cubic feet per minute. *Trinity Equipment Corporation*.

Circle number (60) on reply card.

Call in a

DURA MAN

for expert advice on mechanical sealing...

DURA SEAL

Sales and Service is Nation-wide

Mechanical sealing service at its best! Fifty-six trained men working out of thirty area offices offer assistance in meeting your sealing needs.

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO, MICHIGAN

Refining Literature

Nozzle Bulletin

High capacity spray nozzles for producing hollow-cone sprays are described in new bulletin which includes information on capacities, sizes, dimensions, and materials of construction — plus photo showing liquid spray distribution of operating nozzle. *Schutte and Koerting Company*.

Circle number (61) on reply card.

Pipe Data Card

Technical data card for engineers, buyers and others interested in purchasing of pipe has been published by the *Tubular Products Division of The Babcock & Wilcox Company*. Identified as TDC-191, this card contains dimensions and weights per foot of pipe in sizes ⅛ in. through 36 in. for all schedules.

Circle number (62) on reply card.

Inspection Chapter Announced

Availability of Chapter XII, Foundations, Structures, and Buildings, of the Guide for Inspection of Refinery Equipment, has been announced by *the Division of Refining of the American Petroleum Institute*. The 19-page chapter covers descriptions of types, reasons for inspections, causes of deterioration, methods of inspection, and other inspection information.

Circle number (63) on reply card.

Flotator Booklet

Process flotators for industrial waste treatment, oil and grease recovery and sludge thickening are presented in Bulletin SM-1003 by *The Eimco Corporation*.

Circle number (64) on reply card.

Automatic Controls

Packaged automatic control panels for gas-engine-driven compressors are presented in an illustrated bulletin by *Clark Bros. Company*. Three basic control panels are described: Sequenced engine control, fully automatic engine and compressor control, and fully automatic control for remote location.

Circle number (65) on reply card.

Fin Tube Bulletin

Advantages and performance characteristics of longitudinal finned-tube heat exchangers and thermal heaters are described in a new bulletin available from *Alco Products, Inc.*

Circle number (66) on reply card.

Computers For Engineers

Details of *The M. W. Kellogg Company's* new system whereby engineers unfamiliar with computer language can utilize the computer for their calculations, and many of the ways the digital computer is used as a process and design engineering tool are given in a new 12-page Kelloggram "The Computer: New Era in Engineering," just published.

Circle number (67) on reply card.

Installations Handbook

New edition of Spang conduit and fittings handbook-catalog has been issued by *The National Supply Company*. Contains illustrated descriptions of installations in all kinds of buildings, specifications for estimating and planning electrical installations and standard symbols for drawings.

Circle number (68) on reply card.

Differential Pressure Units

Three bulletins from *Barton Instrument Corporation* discuss three instruments which indicate, measure or transmit flow rate, liquid level and differential pressure. They are Model 250, differential pressure switch; Model 237, differential pressure controller, and Model 214, indicating pneumatic transmitter.

Circle number (69) on reply card.

Specifications Manual

To aid in specifying heat exchangers a specifications manual has been published by the *Brown Fintube Company*. The reference serves as a guide to the specification writer or engineer who desires to simplify heat exchanger specifications by using a single modular hairpin unit for all duties.

Circle number (70) on reply card.

Solenoid Valves

Over 200 solenoid valves of bronze and stainless steel construction are listed in a new catalog from *Atkomatic Valve Company*.

Circle number (71) on reply card.

IF YOU HAVE THREADED FITTINGS

YOU NEED

LED-PLATE

ANTI-SEIZE SEALING COMPOUND

BOLTS
INSERTS
PIPE
STUDS

ASSEMBLY
MAINTENANCE
PRODUCTION

HIGH TEMPERATURE ANTI-SEIZE
No heat freeze, Temp. range -350°F to +2987°F
MEETS GOVERNMENT SPECIFICATIONS
Mil-A-907 QPL-907

WRITE FOR FREE SAMPLE

NO GALLING OR SEIZING recommended for aluminum, stainless, titanium, plastic, steel, brass, etc.
HIGH PRESSURE SEALANT a real thread sealer, pressures held to 50,000 psi hydraulic fluids, 3500 psi air, 1000 psi gases. Has UL approval. For gases, steam, air, ammonia, hydraulic fluids.
CORROSION PROTECTION no corrosion weld, prevents rusting, acid-etch, etc.

SPECIFICATION COMPOUNDS IN STOCK

JAN-A-669	SPEC. OXYGEN SEAL
MIL-T-5544	NAVORD OSTD-53
MIL-A-13883	CUSTOM COMPOUNDING

See your supply store for Armite drill collar and joint compound

ARMITE LABORATORIES
6609 Broad Street
Los Angeles 1, Calif., U.S.A.

PIPELINE Engineer

Pipelining Abroad – Year's Biggest Line

Two Outstanding Firsts

First major transmission line to be completely cleaned and taped

As the first major transmission line to be cleaned and taped from start to finish, Houston Corporation's 24-inch pipeline from Baton Rouge, Louisiana, to Cutler, Florida, marks another outstanding achievement for the pipeline industry.

First successful combination cleaning and tape wrapping machine

Using counter rotating C-R-C Combination Cleaning and Tape Wrapping Machines exclusively, Midwestern-Walco Construction Company has averaged 8,000 to 10,000 feet per day on their spreads in Louisiana, Mississippi, Alabama, and Florida. Midwestern-Walco is responsible for approximately 700 miles of 24-inch main line of the Houston Corporation line, 25 river crossings and 3 compressor stations.

The C-R-C Combination Cleaning and Tape Wrapping Machine pictured above has been used on over 100 miles of pipe and is still going strong. It is equipped with:

- "Long-Life" C-R-C Crawler Wheels.
- Cup brushes on the cleaning heads.
- A blower to remove fine dust particles from pipe prior to tape and outerwrap application.

The machine is operated without the aid of a hoosier pole and outrigger wheel.

CRC

CRUTCHER · ROLFS · CUMMINGS, INC.

Home Office: Houston, Texas, Box 2073, UNderwood 4-6391

Branch Office: Farmington, N. M., Box 1207, DAvis 5-5523
Export Office: International Oil Equipment Co., 30 Rockefeller Plaza, New York, N. Y., COlumbus 5-6250
In Canada: Canadian Equipment Sales & Service Co., Ltd., 7310 99th St., Edmonton, Alberta, Canada

now...

a PHENYLENE DIAMINE TYPE ANTIOXIDANT

that has everything...

UOP 88®

- Prevents gum formation, stabilizes tetraethyl lead in both motor and aviation gasolines
- Acts as catalyst in air-oxidation of mercaptans
- A 100% active ingredient
- Remains liquid at all ambient temperatures
- Non-toxic—non-irritating to skin
- Reduces engine deposits
- Approved for use in pipeline systems

Lowest-cost phenylene diamine type antioxidant now in commercial use —write for information and samples. Address our Products Department.

UOP

UNIVERSAL OIL PRODUCTS COMPANY

30 Algonquin Road, Des Plaines, Illinois, U.S.A.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Foxboro Capacity Dynalog* Recorder, located upstream from receiving station, records dielectric constant of pipeline product — telemeters it ahead to delivery point.

New Accuracy in Interface Detection!

Unique Foxboro System profiles interface in advance — helps reduce product contamination at switch-over

Now your pipeline dispatchers can accurately chart the shape of an interface in advance — pinpoint their switch-over of product runs!

The Foxboro Pipeline Interface Detection System is based on the fact that even slight differences in grades of petroleum products have measurably different dielectric constants. Sensitive capacity Dynalog* Recorders measure this difference, both at the pipeline delivery station, and at a point one or two miles upstream. Foxboro Teletax* Telemetering brings the two measurements together on a single chart at the delivery station.

From the shape of the upstream record, the dispatcher selects the best cut point well before the interface arrives, and sets index at this point. When station interface record matches index, switch-over is made.

Foxboro Interface Detection eliminates sampling and guesswork — holds product contamination and loss to a new minimum. Systems in use today include both dual-measurement and single-measurement systems. Ask your nearby Foxboro Field Engineer about them, or write for Bulletin 20-11. **The Foxboro Company, 386 Norfolk St., Foxboro, Massachusetts.**

*Reg. U.S. Pat. Off.

2-pen Capacity Dynalog Recorder, at delivery station. One pen records dielectric interface measurement telemetered from upstream station. Second pen records measurement at delivery station. From upstream record, dispatcher selects best cut point, and aligns index with this point on chart. When second pen matches index, switch-over takes place, either automatically or manually.

FOXBORO

REG. U.S. PAT. OFF.

INTERFACE DETECTION SYSTEMS

Through swamps . . . over hills pipeline work moves <u>faster</u> with the all-new

INSLEY M

Take the roughest terrain. Then put the new Insley M on the job and watch how pipeline trenching moves ahead—*faster!* Dependability is one reason. The rugged components of the Insley M are designed to stand up under the severest operating conditions. "Power matching" is another. The engine is correctly matched to the machine's capacity—for *maximum* efficiency. And here's a host of other reasons why you'll hear more and more pipeline contractors talking about the Insley M.

May 14-23, 1959, Tulsa, Oklahoma.
See Insley's exhibit—East end, Block 9.

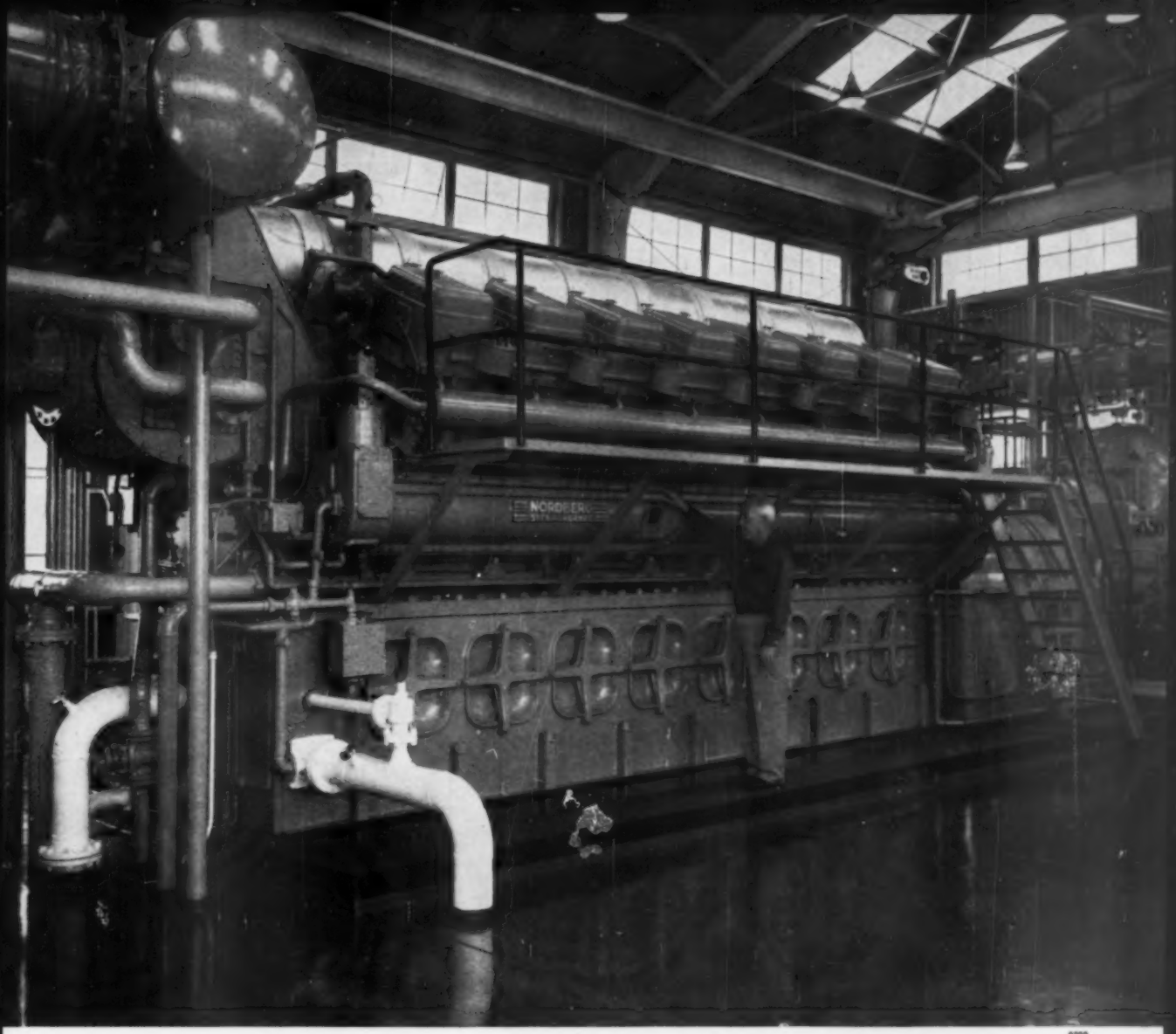
- Heavy-duty ¾ cu. yd. excavator • 15-ton crawler crane 20-ton rubber mounted crane.
- Wide-vision cab.
- Dependable mechanical clutches.
- Large diameter turntable with internal bull gear.
- Anti-friction bearings, aluminum bronze bearings and involute shaft splining.
- Wide, deep design crawler carbody.
- Sealed crawler rollers and end tumblers (optional).
- 12-ft., 6-in. crawlers standard.

THERE'S AN INSLEY WORKING NEAR YOU

Heavy-Duty Hoe Attachment • Box-Type Jack Frame • Brake-Type Cab Lock • Optional: Two-Speed Travel • Independent Travel • Independent Boom Hoist • Digging Dogs

INSLEY MANUFACTURING CORPORATION

General Offices—Indianapolis 6, Indiana • West Coast Division—Los Angeles 54, Calif.



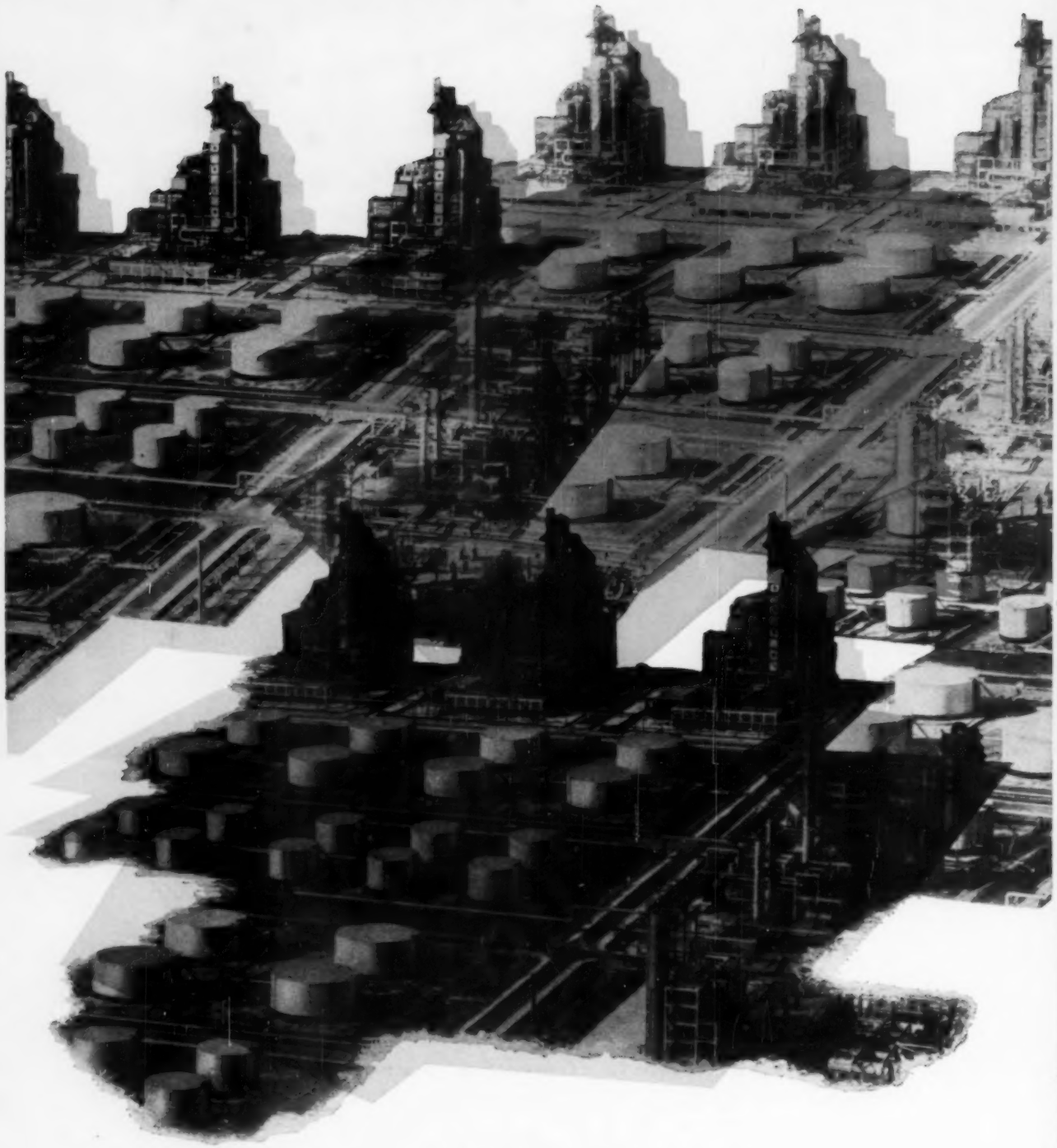
Pipe line engines by Nordberg

One of four Nordberg *Supairthermal*® spark-ignition gas engine-gear sets driving centrifugal compressors in Transcontinental Gas Pipe Line Corporation's Station No. 23.

NORDBERG MANUFACTURING COMPANY
MILWAUKEE 1, WISCONSIN

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS
NEW ORLEANS • NEW YORK • ST. LOUIS • SAN FRANCISCO • TAMPA
WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO D. F.

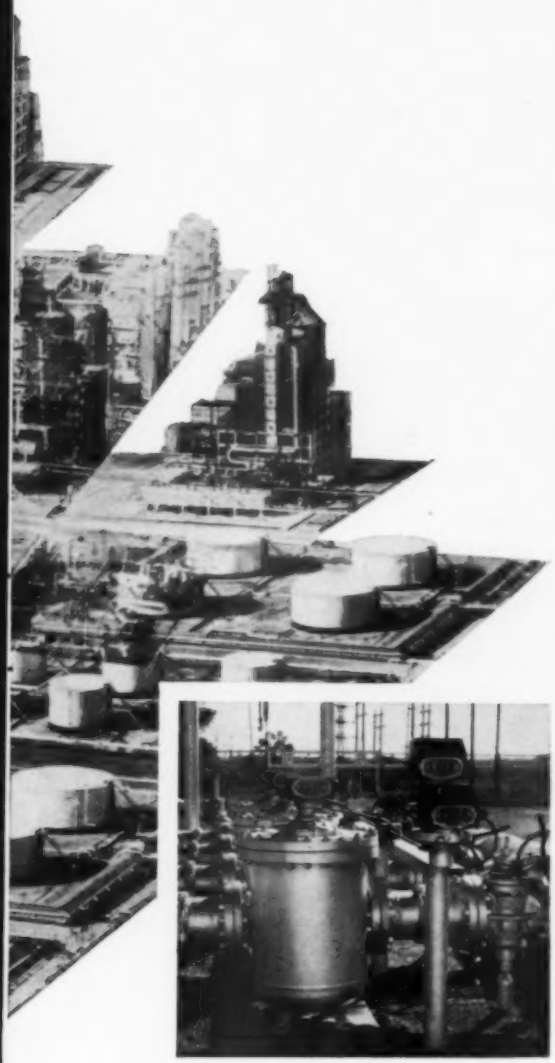
"Engineered



FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD

meter systems"-

newest way to refinery expansion without buying real estate



With individual capacities ranging up to 3000 bph, these four A. O. Smith B-200 meters receive crude from a 16-inch line. Meters are connected by combinator units that register total throughput on counter-shifter ticket printer (foreground).

The road to expansion of refining facilities is frequently strewn with barriers — local zoning restrictions, expensive real estate or lack of available adjoining land.

To avert these drawbacks, more and more major pipeliners and refiners are turning to A. O. Smith engineered meter installations. Large volume A. O. Smith meters release measurement tankage for storage purposes . . . provide faster, less complicated throughput . . . reduce overall capital investment . . . slash tank filling and breathing losses.

Equally important, A. O. Smith engineered meter systems provide exceptionally accurate measurement of all transactions.

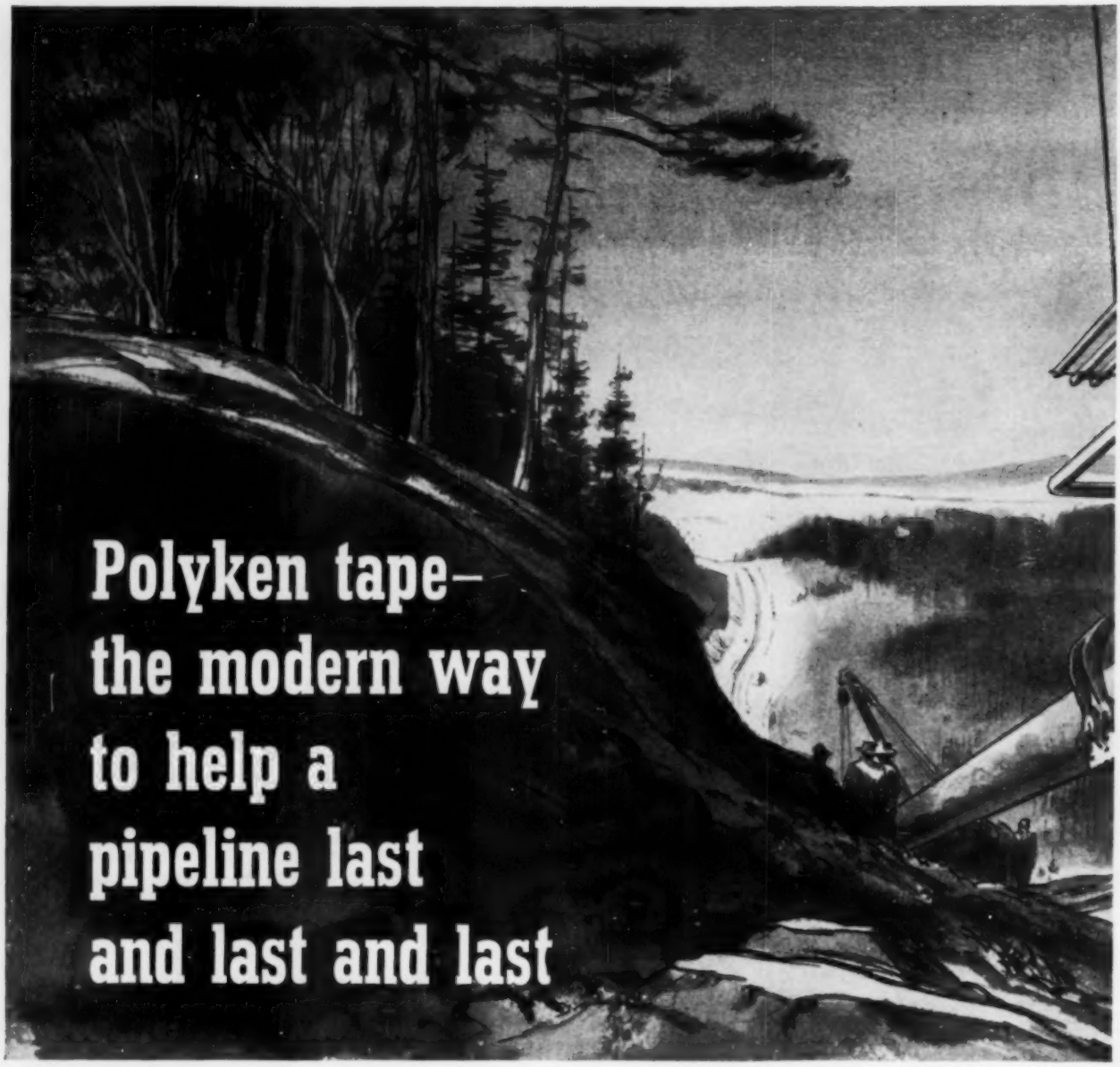
Before you plan tank-farm expansion you'll be money ahead to consult A. O. Smith. There are meters and accessories for every receiving line — crude, LPG or natural gasoline . . . models for a wide range of operating pressures. And, A. O. Smith meters are equally accurate in measuring finished petroleum products . . . offer similar space saving advantages. Contact your man from A. O. Smith today or write direct:

Through research . . . a better way

A.O.Smith
CORPORATION

Smith-Erie Division

Factories: 5715 Smithway St., Los Angeles 22, Calif.; Erie, Pa.
Offices: Atlanta 5, Ga.; Chicago 3, Ill.; Houston 2, Texas; Los Angeles 22, Calif.; New York 17, N. Y. Canada: Toronto 12, Vancouver 1.
A. O. Smith INTERNATIONAL S. A. Milwaukee 1, Wisconsin, U.S.A.



Polyken tape—the modern way to help a pipeline last and last and last

Polyken polyethylene tape, noted for its construction economies, now proves its dependability on the big jobs.

There's good reason why more and more pipeline is coated this way today—the modern way—with Polyken tape.

The reason is *performance.*

Take the experience of the Houston Texas Gas and Oil Corporation—the largest single pipeline coating order in history.

First, they had their engineering staff give Polyken intensive corrosion-resistance and performance tests. They checked the experience of other users. They studied tape construction practices as an important source of applied quality control. They analyzed tape coating spreads and saw the actual difference in unit operations and costs between the Polyken method and the ordinary enamel method.

Polyken passed with flying colors.

Then they added up the dollars and discovered that a Polyken-wrap job would save them better than half a million dollars, compared with the conventional "hot dope" coating.

Advantages like these can be yours. To get the full story on how Polyken can do a better job for

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

you—and save you money—call your Polyken Representative, or write Polyken Sales Division, 309 W. Jackson Blvd., Chicago 6, Illinois.

Polyken®

EXPERIENCED IN PROTECTIVE COATINGS

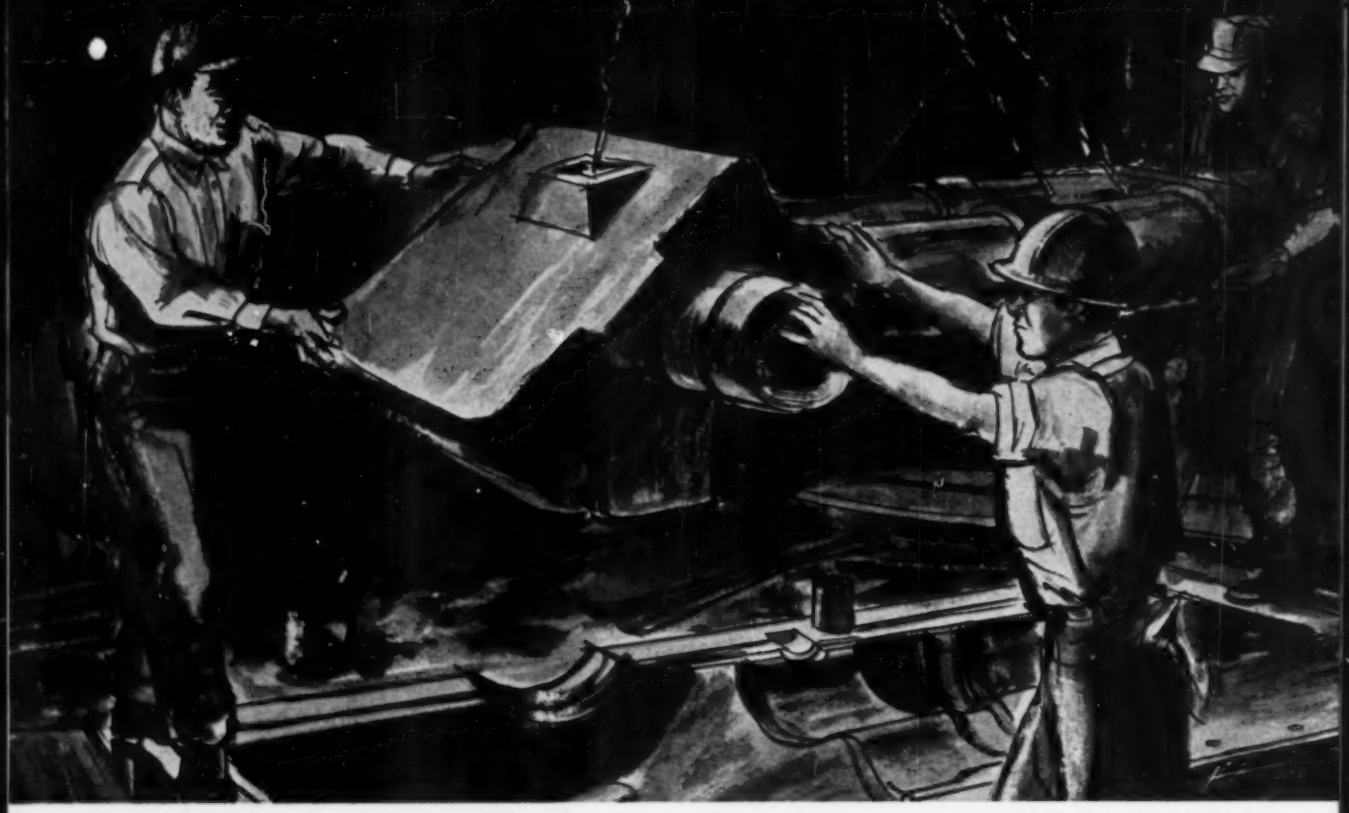
THE KENDALL COMPANY

Polyken Sales Division

↑ Pipeline is simultaneously cleaned and wrapped. Polyken Tape (dark spools) goes on without a primer, in factory-uniform condition... then is overwrapped (gray spools).

← The Houston line gets Polyken-wrapped pipe into the ditch immediately after coating. Fieldmen say this method makes for a tight, clean, fast spread.

FOUND IN THE FOUNDRY



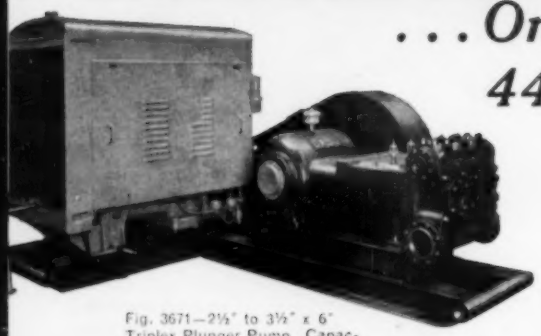


Fig. 3671—2½" to 3½" x 6" Triplex Plunger Pump. Capacities of 191 to 375 barrels per hour at working pressures from 1575 to 800 PSI.

...One of the Secrets of GASO'S 44-Year Record of Leadership

No pump is stronger than the metal from which it is made, and no pump manufacturer casts his metal to more rigid specifications than Gaso. Here experienced foundry-men are preparing the mold for a Gaso power frame. Into it will be poured a special formula of molybdenum alloy cast iron. Test bars, sent regularly to a nationally known laboratory, consistently show a tensile strength of 45,000 to 48,000 lbs. per square inch. Another reason for the ruggedness of Gaso Pumps, their ability to withstand the shocks and strains of tough use, and their habit of outliving ordinary pumps . . . Latest catalog on request.

GASO PUMP & BURNER MFG. CO. Export Office: Empire State Building
101 East First Street, Tulsa, Oklahoma New York, N. Y.

DISTRIBUTORS:

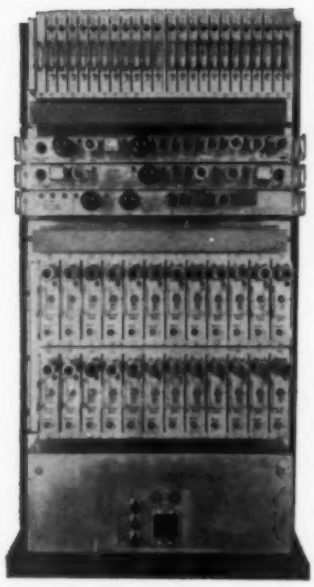
Farmington, N. M.—Gaso Pump & Burner Mfg. Co.
Shreveport, La.—W. L. Somner Co.
Odessa, Texas—W. L. Somner Co.
Brookhaven, Miss.—W. L. Somner Co.
Tinsley, Miss.—W. L. Somner Co.
Hobbs, N. M.—W. L. Somner Co.
Houston, Texas—Peddlers, Inc.
Wichita Falls, Texas—Pump Engineering Co.
Evansville, Indiana—Hague Equipment Co., Inc.
Long Beach, Calif.—Power Pumps, Inc.
Casper, Wyoming—Lufkin Foundry & Machine Co.
Edmonton, Alberta, Canada—Lufkin Machine Co., Ltd.

GASO PUMPS
for every oil industry need

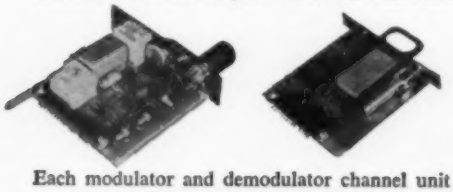
100th Anniversary of Oil in America 1959 **44th Anniversary of Gaso Leadership**

Kellogg Sets New Standards of Reliability in Microwave

Backed by the world-wide technical, manufacturing, installation and operating experience of ITT



New MICROPLEX provides 23 plug-in channel units in 3½ feet of space—a 4:1 size reduction



Each modulator and demodulator channel unit features printed circuitry.

Microwave was pioneered by ITT in 1931 with the Channel crossing from Calais to Dover. Today Kellogg Microwave is achieving new levels of reliability: 99.998%, far superior to wire line systems! Operating in dozens of installations throughout the world, Kellogg's *complete* communications package includes:

- *Microwave* — operating in the 2,000 and 10,000 megacycles bands.
- *Terminating Equipment*—for automating functions, including teletype, telemetering, remote control, data transmission.

Part of the Kellogg 10-C Microwave System is the new 10-C-2 "Microplex": a 23 or 45 channel PTM multiplexing equipment. It features printed circuits, miniaturized components, minimum maintenance, and occupies only three-and-one-half feet of rack space. All demodulators are semi-passive—only one tube per channel; modulators are passive—no tubes. The 23 channels use 41 tubes with an input of 180 watts —a 5:1 reduction in power consumption.

MICROPLEX may also be packaged in one seven-foot rack to provide 45 channels; or 23 channels with two-wire termination and tone signaling. Signal crosstalk is 62 db and signal-to-noise (F1A) is 70 db for 23 channels.

Our engineering staff is always at your service—ready to discuss your communications problems. Write for complete details.

Kellogg Switchboard and Supply Company,
6650 S. Cicero Avenue, Chicago 38, Illinois.
Communications Division of International Telephone and Telegraph Corporation.

Regional Offices and Warehouses:

CALIFORNIA
23 Broderick Road
Burlingame, Calif.
OXford 7-5780

GEORGIA
1594 Southland Circle, N.W.
Atlanta 18, Georgia
SYcamore 4-2441

ILLINOIS
4600 So. Tripp Ave.
Chicago 32, Illinois
CLiffside 4-4300

KANSAS
7th & Sunshine Road
Kansas City 15, Kansas
MAyfair 1-4418

MINNESOTA
6100 Excelsior Blvd.
Minneapolis 16, Minn.
West 9-6715

NEW YORK
327 North West Street
Syracuse, New York
HArrison 2-9251

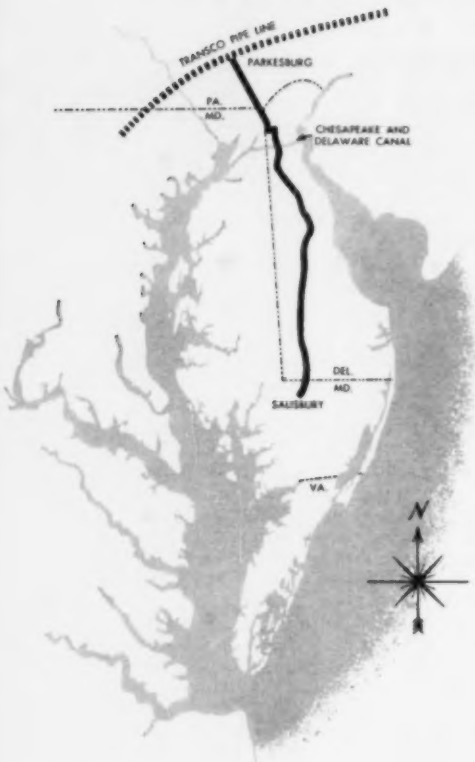
OHIO
1555 West Fourth Street
Mansfield, Ohio
LAfayette 4-6511

TEXAS
1515 Turtle Creek Blvd.
Dallas 7, Texas
RIverside 7-5191

EXPORT 157 Prospect Street, Passaic, New Jersey
PRescott 3-5100

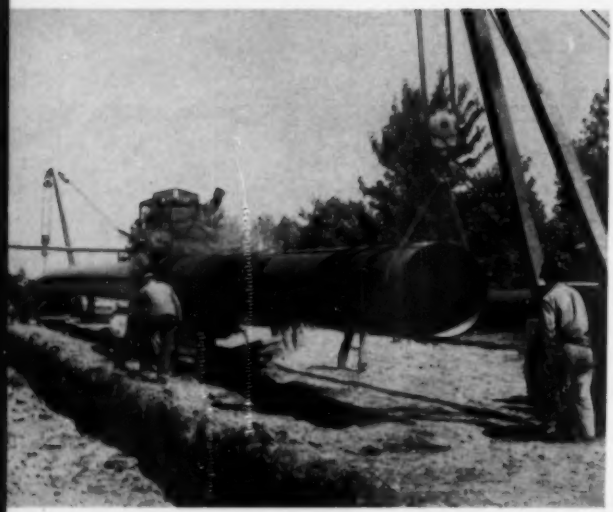
KELLOGG Communications Division of ITT
CHICAGO, ILLINOIS

Eastern Shore's New Gas Line



With the erection of this 1280 ft pipeline suspension bridge over the Chesapeake and Delaware Canal near Newark, Del., Eastern Shore Natural Gas Company's new 124-mile pipeline was completed and ready to serve waiting customers. The entire line had been laid and tested prior to the canal crossing, which linked-up the 8⅝-in. OD northern section with the smaller 6⅝-in. OD southern section.

Built with Bethlehem steel pipe—some 5,000 tons of it—the new line taps Transco's main line near Parkesburg, Pa., and runs as far south as Salisbury, Md. The line was installed by Buchanan Pipe Line Company. Over-all advisory services were supplied by Stone & Webster Service Corporation.



Transco's 36-in. OD looping line in southeastern Pennsylvania also required many tons of Bethlehem pipe. Looping along the entire length of the trunk greatly increased Transco's capacity.

Expert handling together with the uniform quality of Bethlehem pipe speeded installation of Eastern Shore's new pipeline. Noland Co., Inc., Washington, D. C., was the jobber.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Leaps 1280 ft Across Canal

Need Line Pipe? Bethlehem makes hydraulically expanded electric fusion-weld pipe from 18-in. through 42-in. OD, in 40-ft lengths; electric resistance-weld pipe from 5 in. (nom.) to 16 in. OD, in lengths to 60 ft; and continuous buttweld pipe ½ in. to 4 in. (nom.) in various lengths. All Bethlehem steel pipe meets the appropriate API specifications.

Contact the nearest Bethlehem Steel sales office for full information. Our engineers will be glad to assist you.

▲ QUARTER-MILE SPAN

Two 50-ton towers, plus strong Bethlehem wire rope and bridge strand, support the 12-in. steel pipe 140-ft above the Chesapeake & Delaware Canal. The structure was designed by Clear Span Engineering Co., Houston, and erected by Midwestern Contractors, Inc., Wheaton, Ill. The tubular steel towers were fabricated by Trinity Steel Company, Dallas, Tex.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

For a wide range of applications in—

Communications

Data Processing

Automation

Model 28 RT Sets may be mounted in pairs in this newly designed Teletype Universal Cabinet, ideal for office or communications center installation.

New Teletype Model 28 RT Set

The Teletype Model 28 Reperforator Transmitter-Distributor Set features three automatic data handling facilities in one unit. It combines: (1) a typing or non-typing TAPE PUNCH . . . with (2) a TAPE READER . . . plus (3) intermediate TAPE STORAGE facilities.

This new equipment will accept signals at line speed, convert them into perforations in paper tape, and re-transmit the data at the same or another speed.

The Model 28 RT Set is adaptable to a wide range of applications in—

Communications. For high speed, cross-office relaying of messages through automatic switching centers . . . for automatic linkage between communications lines operating at different speeds . . .

Data Processing. For automatic linkage between business machines and communication lines . . . for automatic accumulation of data from IDP systems . . .

Automation. For automatic linkage between incoming control data and signal-operated factory equipment . . . for automatic relaying of telemetered data over communication lines.

Speeds from 368 to 1,200 characters per minute are available for 5-level code. A manual gearshift permits selection of 368, 460 or 600 operations per minute with either typing or non-typing tape punches. Units with non-typing tape punches operate at 1,200 operations per minute with a fixed gear arrangement.

If you would like more information about this new and versatile Teletype unit, please write for descriptive literature to: Teletype Corporation, Dept. 90F, 4100 Fullerton Ave., Chicago 39, Illinois.

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company*, INC.

Cut Maintenance and Replacement Costs with TAPECOAT®

...the Coal Tar Tape Coating that Adds Years of Service Life to Gas Lines

No wonder more and more distribution engineers are selecting TAPECOAT products as an important part of their program in fighting underground corrosion! Experience shows that quality protection applied during installation prevents huge maintenance and replacement expense at later dates.

Since 1941 when TAPECOAT originated coal tar coating in tape form, it has proved to be the best protection money can buy for combatting corrosion underground or under water. Lines in service TAPECOATED as far back as 17 years ago show no signs of deterioration – a record of uninterrupted service no other type of tape can match.

TAPECOAT comes in rolls of 2", 3", 4", 6", 18" and 24" widths–sized to the job for protecting pipe, pipe joints, couplings, fittings, tanks, conduit, cable and tie rods. TAPECOAT is both bond and protection in one–easy to apply with the flash of a torch.

Write for brochure today.

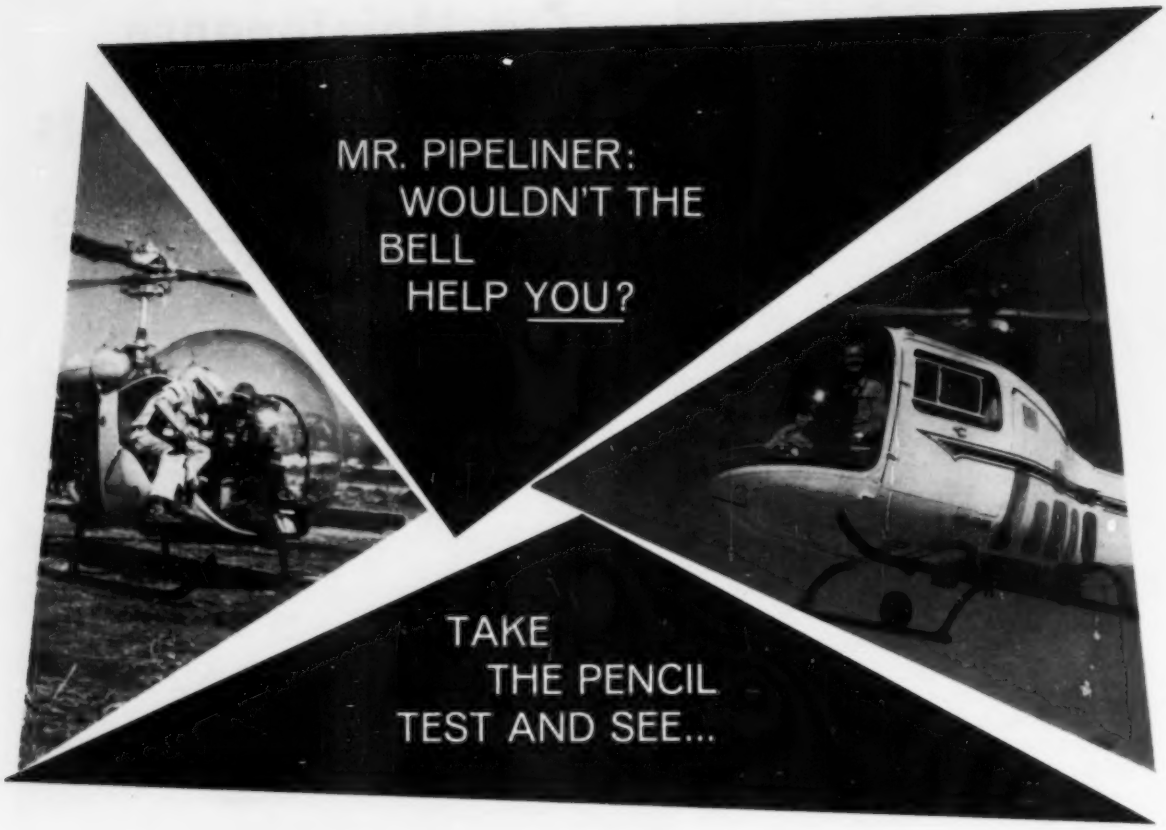
When primer is specified, use TC Primecoat, the compatible coal tar primer.

The TAPECOAT Company

1567 Lyons Street, Evanston, Illinois

Representatives in Principal Cities

Manufactured and distributed in Canada by The Tapecoat Co. of Canada, Ltd., 25 Haas Road, Rexdale, Ontario



How does a pipeline man use his Bell helicopter? For some time we've been gathering operational data from Bell users. Among it are striking cases of how imaginative contractors make big capital out of a versatile machine. But these are frosting on the cake. The "cake" itself is the Bell's ability to start for you, today . . perform half a dozen basic jobs . . improve efficiency and save you money in the bargain. To see what we mean, answer these questions. Then ask yourself . . isn't it time to try a Bell now?

YES	NO	
☐	☐	Could we sharpen up our contract bids (and eliminate errors in surveying) by getting a closer look at the proposed right of way?
☐	☐	In pipe stringing, do we have a major problem of communications between work units?
☐	☐	Would it save costly supervisory time if we could get inspectors *quickly* to any spot along the right of way?
☐	☐	Ever consider the morale factor of having instant air-ambulance service to any job site in the wilderness?
☐	☐	Could we impress more prospects by showing them our work-in-progress, from the air and at close range?
☐	☐	Do our estimators know that Charter Helicopter Service is easily available for trial and experimentation?

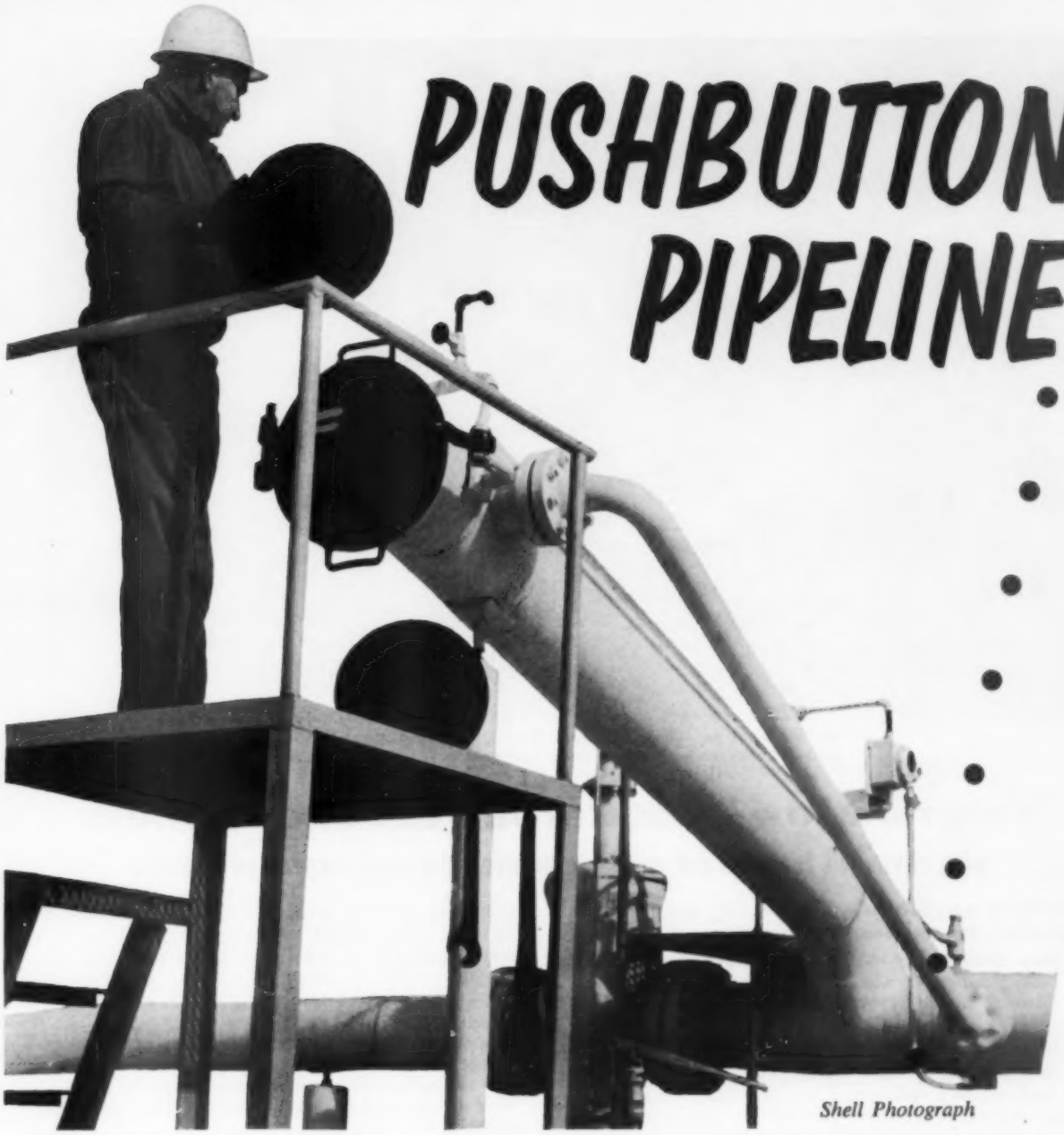
Now tear out this page and send with your name, title, company and address to: Department 35F, Bell Helicopter Corporation, Fort Worth, Texas. We'll send you additional information about the Bell's role in Construction and Utilities.

BELL

HELICOPTER CORP. FORT WORTH 1, TEXAS • SUBSIDIARY OF BELL AIRCRAFT CORPORATION

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

PUSHBUTTON PIPELINE



Shell Photograph

- This "magazine loading" launching barrel contains up to ten Pipe Line Spheres. After initial loading, a Sphere is launched with a push of a button. One or more succeeding Spheres can then be similarly launched at precise intervals as close as six seconds.
- Suitable for Products, Crude, and Natural Gas Pipe Lines, these automatic Sphere handling devices bring the mechanical phase of Pipe Line automation even closer to true "unattended operation." Other associated equipment includes automatic Station Sphere Bypass and Receiving barrels. It is now possible to conduct squeegee operations with Pipe Line Spheres throughout the length of a Pipe Line — fully automatically.
- Applications for automatic Pipe Line Sphere equipment include: Crude and Products Pipe Lines — Tender separation; with accurately bracketed interface and consequent reduction in co-mingling. Positive displacement meter calibration in loops or on-stream.
  Natural Gas Pipe Lines — Liquid removal. Practical two phase operation for complete recovery of distillates with full Pipe Line efficiency.
- Maloney Engineers are prepared to furnish engineering and components for application. Write for further information.

F. H. Maloney COMPANY

Post Office Box 1777 • Houston 1, Texas

Features of Maloney Pipe Line Spheres and Automatic Equipment Described Herein are Subjects of Patents Pending.

New Model 773 for general utility range (5'6" deep and 24" wide), and new Model 772 with reduced over-all width for tight quarters. Write for new bulletin.

Two new low-cost Barber-Greene ditchers

with advanced features not available on even the most expensive ditchers

All these advantages — offered only by Barber-Greene — mean more ditch per day

- **New Dual-Range Hydra-Crowd Transmission** provides infinitely variable crowding speeds independent of wheel and conveyor drives. No stopping to change speeds . . . no gear shifting. Instant selection of maximum crowding speeds for every digging condition.
- **New Digging Wheel Drive** through telescoping drive shaft, floating differential and split No. 1 shaft cuts maintenance and wear on drive unit . . . assures uniform gear contact on both sides of the wheel.
- **New Power Flow Design** makes all units readily accessible for easy maintenance and gives the entire machine better balance.
- **Optional, All-Hydraulic Spoil Conveyor** eliminates all chains and sprockets . . . provides instant selection of infinitely variable speeds to 630 f.p.m., independent of wheel speed—instant reverse.
- **New Hydraulic Controls** give greatest accuracy in digging to line and grade . . . offer a new high in operating ease. All controls grouped within easy reach for less fatigue and greater operator comfort.
- **New Flexible Drawbar** between chassis and boom reduces transfer of twist and tilt from wheel to chassis when digging around curves or over uneven ground. This design reduces chain length and eliminates idler sprockets.
- **New Crawlers** are easily adjusted in one-tenth the time of ordinary crawlers. Constant tension is provided by predetermined spring loading . . . crawlers quickly loosened or tightened without changing spring tension.
- **Other Features Include:** automatic overload protection, new hydraulic brakes, new hydraulic wheel hoist.

58-42-D

Barber-Greene BG

AURORA, ILLINOIS, U.S.A.

CONVEYORS . . . LOADERS . . . DITCHERS . . . ASPHALT PAVING EQUIPMENT

To make the 11-mile marine crossing of Galveston Bay four lay barges were trained together and equipped with 10 working stations. Ship traffic was not hindered in any way while the crossing was being installed. Here a fully loaded tanker crosses between the lay barge and the spud barge.

Gas Crosses Last U.S. Frontier

Texas-to-Florida system is year's biggest pipeline project: 2602 miles of pipe and eight compressor stations

Frank H. Love, *Editor*

THE LAST MAJOR GAS CONSUMING FRONTIER HAS BEEN CROSSED!

Users in the state of Florida on June 1 began receiving gas through The Houston Corporation's big new pipeline system, which extends all the way from the extreme peak of South Texas. Totaling 2602 miles of pipe and eight compressor stations, this unquestionably will be the largest construction program completed during 1959.

Construction and operation of the pipeline is by Coastal Transmission Corporation and Houston Texas Gas and Oil Corporation. The Houston Corporation owns all the stock of both companies.

Coastal is operating the section from McAllen, Texas, in Hidalgo County near the Mexican border, to Baton Rouge, Louisiana, 976 pipeline miles including gathering systems. Houston takes the gas there and delivers it to consuming points throughout Florida. The Houston Texas part of the system covers 1626 pipeline miles.

The Houston Corporation will own and operate certain distribution systems in the state of Florida. Some of these are older, existing manufactured gas systems that were purchased by Houston and revamped for use of natural gas.

Consummation of this gigantic project was a long and arduous road. It began in the mind of the late J. O. Mack, whose original intention was to take Texas and Louisiana gas to certain Midwest and Eastern areas. In studying this proposal researchers were led into a bypath that revealed Florida to be a virtually untapped market and the logical direction to go with the gas. F. E. Stanley, president of Midwestern

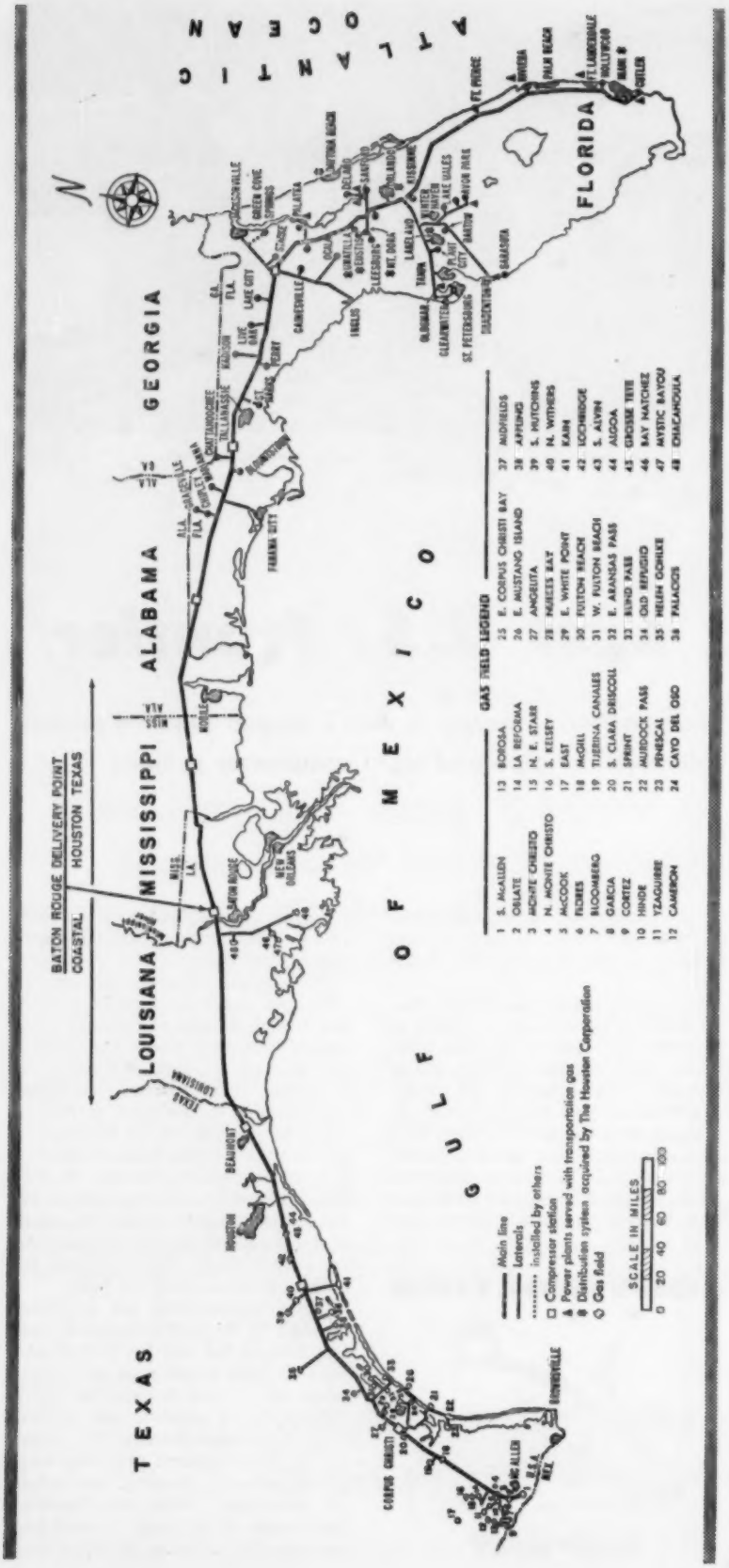
CONSTRUCTION

REPORT

Constructors, Inc., and the Clint Murchison interests eventually became a part of the project.

The original conception was early in 1953, but it was not until May 1958, that the green light was turned on to stay. The Federal Power Commission had granted a conditional permit in December 1956; however, competing fuel interests in the state of Florida asked for a review of the FPC orders by the United States District Court of Appeals in Washington, D. C. The United States Court of Appeals for the Dis' 'ct of Columbia upheld the action of ... Federal Power Commission and the United States Supreme Court denied certiorari on May 19, 1958.

Actual construction got underway October 15. With completion of main transmission line and key lateral sales lines on June 1 this adds up to only seven and a half months for laying 2400 miles of pipeline and building eight compressor stations. The expianation of this unusual speed was manpower, advance planning, and technical knowledge. More than twoscore contractors of all kinds . . . main line, laterals, river crossings, stringing, yard



Route of the 2602 mile pipeline from McAllen, Texas, to various points throughout Florida.

coating, etc. . . . were instrumental in laying the pipeline. Five contractors installed the compressor stations.

Need for the Line

Previously, Florida depended for its energy supply on petroleum products (fuel oil and LPG), manufactured gas, and electricity. Coal was not a major factor because of the great distance of coal fields from Florida. There are only three small hydro-electric dams in the state, and many of the manufactured gas facilities were in poor condition. Thus, the state was almost completely dependent on petroleum products for motive power, heat, and electricity.

Two of the major customers of the new pipeline are the Florida Power Corporation and the Florida Power & Light Company, who will use the gas as fuel in their generating plants. These companies are purchasing gas direct from producers and Houston Texas Gas and Coastal are acting only as transporters. This was an important phase of the planning since, by serving merely as a transporter for these users, FPC has no jurisdiction over transportation gas.

For Florida Power an average of 50,000,000 cu ft a day will be transported, and for Florida Power & Light 100,000,000 cu ft a day. The remaining 132,000,000 cu ft of the pipeline system's initial daily capacity will be sold to 34 resale distributors and 17 industrial customers.

Under the operating setup, Coastal has made all the gas purchase contracts, other than those made for themselves by the two power companies, and delivers to Houston Gas and Oil, its sole customer, on a cost-of-service basis. The purchase contracts provide for an initial price of 16 to 18 cents per Mcf in Texas, and 18 cents plus 1 cent gathering tax in Louisiana. Provided also is escalation of 1 cent per Mcf on July 1, 1962, July 1, 1967, and July 1, 1972, to expiration of the contract subject to agreement by regulatory bodies having jurisdiction.

COASTAL TRANSMISSION SYSTEM

Coastal's 976 miles of pipeline consist of 561 miles of main line and 415 miles of supply laterals. Gas is being taken from 48 fields starting in South Texas and extending up the Gulf Coast of Texas and Louisiana. Between McAllen and Baton Rouge the main line consists of 95 miles of 12-in., 151 miles of 20-in., 63 miles of 22-in., and 252 miles of 24-in., for a total of 561. Diameters of the 415 miles of gathering

Welding procedure was to run a stringer bead, hot pass, filler, and cap. A crew of 11 welders made between 135 and 140 welds a day.

On the Coastal portion of the system the pipe was coated with hot enamel to a thickness of 3/32 in. and wrapped with 15-lb asbestos felt. On the discharge side of stations a glass fiber wrap also was applied.

and feeder lines scale from 14-in. down to 2-in.

Most of the laterals are in Texas. There are, however, some important ones in Louisiana. One is an 80-mile combination 6, 12, and 14-in. line to the Chacahoula and Mystic Bayou fields south of Baton Rouge. This line is in the swampy area characteristic of the lower coast of Louisiana, and was laid by flotation canal, pushes, and conventional land methods.

Marine Crossings

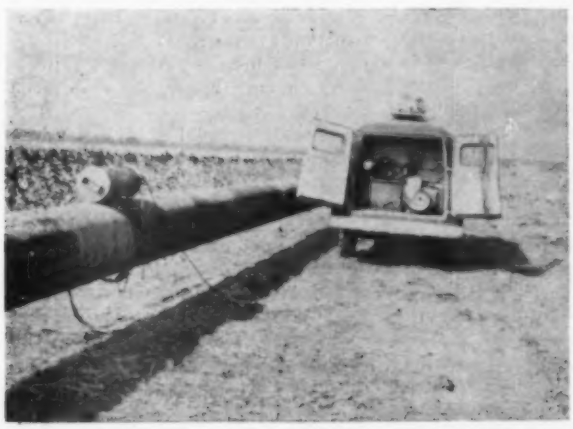
Numerous bays and rivers were crossed by Coastal. Special contracts were let for Galveston Bay and the Neches, Atchafalaya, and Mississippi rivers. Other crossings were installed by the main line contractor. The Colorado, Brazos, Neches, Atchafalaya, and Mississippi rivers are all dual crossings.

Pipe used in water crossings was concrete coated to give a specific gravity of 1.3. Except for the Mississippi River, all crossings were pulled. In the case of the Mississippi, dual 24-in. lines were laid from barges. This crossing is 1.7 miles wide. Dual 24-in. lines were also laid across the Atchafalaya, but they were pulled in the same manner as the single line crossings as the width of this river is only 0.6 mile.

By far the longest marine crossing on the system was that of Galveston Bay . . . 11 miles. In addition to the width, a further complicating element was the fact that the busy Houston Ship Channel cuts through the Bay. To lay the 24-in. concrete-coated pipe from San Leon across to Smith Point special equipment and procedures were adopted. For the first time on a job of this type, four barges were trained together to form a working area 460 ft long. On them 10 working stations were set up, 6 for welding, 1 for X-raying welds, 1 for cleaning and priming, 1 for doping, and 1 field mold station to apply concrete to the welded joint ends. To avoid hindering traffic through the Ship Channel, pipe was laid up to the west side of the channel and cut. The lay barges then were towed across the channel and spudded in. A spud barge with a pulling unit was placed on the west bank of the channel and the pipe string was pulled across. Pontoons were strapped onto the pipe string at intervals to decrease the negative buoyancy of the pipe and enable the spud barge to make the pull of the heavy string.

Terrain

The terrain on the Coastal system is almost as well known to contractors as the back of their hands. It is an area of interlaced pipelines, many of them laid by the same men who did the Coastal job. In extreme South Texas light caliche soil is found. In some spots rippers were used on tractors before ditchers were run, but very little blast-



Specifications required that 20 percent of the main line welds be checked by X-ray, and all welds on water, highway, and railroad crossings.

Coating and wrapping machine moves through a swampy area of Louisiana. Condition of terrain is indicated by the log fill-in needed even by track type tractors.

Installing a main highway crossing is a fast and comparatively simple matter with this type of boring equipment.

ing was necessary. For considerable distances, the soil is loamy, providing generally good working terrain except for periodic river bottoms, tideland marshes, and estuaries. As the line moved farther east and came nearer to its terminus, swampy areas became frequent.

One of the slowing factors in construction was the heavy rains, particularly in February when almost the entire working month was lost.

Line Pipe

Grade X-52 API 5LX pipe was used on the main line for 20, 22, and 24-in. The 12-in. pipe was Grade X-42, and laterals were of various grades. Pipe was in 40-ft joints and was laid that way except for 79 miles on the eastern end, which was double jointed.

Coating and Wrapping

As has been mentioned, pipe in water crossings was concrete-coated. Otherwise, coal tar enamel was used on this section, being applied to a thickness of 3/32 in. This was followed by a 15-lb asbestos felt wrap. On the discharge side of each station, the hot side, further protection was given by the addition of a glass fiber wrap.

Line Testing

The main line was tested hydrostatically, but on laterals both water and gas were used. In the latter case gas sometimes was more readily available than water. Testing was at pressures of not less than 1205 psi, providing a safe margin as the main line will be operated at 975 psi and laterals at 1000 psi. Tests were made on 20-mile sections unless accessibility and water supply dictated otherwise.

Welding and Weld Testing

Welding procedure was to run a stringer bead, hot pass, filler, and cap. Sometimes a strip bead was added if the weld metal was not flush with the pipe. Usually 135 to 140 welds a day were made by a crew consisting of six finishing welders, two on the first bead, and three on the hot pass. Specifications called for 20 percent of the welds to be checked by X-ray on the main line, and all welds on water, highway, and railroad crossings.

Main Line Valves

Full opening valves were installed on spacings not to exceed 20 miles, the exact distance depending upon terrain and accessibility. Crossover and blowdown is provided at each valve.

Double Jointing

Pipe was double-jointed for 79 miles of the 131-mile section of main line between Lake Charles and Baton Rouge, Louisiana. The 40-ft joints were made into 80-ft sections by a new procedure designed to move automatic welding closer to the pipeline right-of way. Double-jointing was by Bechtel Corporation for Oklahoma Contracting Company, the prime contractor.

In this new technique, completely automatic all-outside welds are made by the submerged-arc process. There is no internal welding and no manual welding, and equipment is sufficiently portable to work close to the right-of-way.

Forerunner of the process was an automatic welding machine Bechtel developed for use in constructing the Trans-Arabian pipeline in 1947. That equipment featured a water-cooled backing bar that enabled the making of outside welds and double-jointing on the hot Arabian desert. Replacing the rigid water-cooled bar in the new equipment is a flexible glass fiber sleeve, which is held firmly under the welding groove by a lineup clamp. This sleeve conforms to the contour of the joint even where offset and irregularities occur and allows the metal to solidify without cold laps.

Work flow is similar to other double-jointing plants, but there is less equipment. The plant has facilities for storing single length pipe on a rack, and for lining up and butting the joints on a lineup table. Pipe is cleaned by the same methods as for manual welding.

Pipe alignment is by means of a pneumatic lineup clamp that presses expandable, full circumference, segmented backup shoes against the underside of the weld joint. The backup shoes hold the glass sleeve tightly against the joint to provide a smooth uniform inside contour of the weld.

The welding head "floats" vertically and horizontally over the joint so that irregularities in the pipe are corrected automatically.

An unusual feature is a dog-leg compensator that helps align the pipe and relieve stress at the welding groove.

Voltage, amperage, arc travel, and offset are preset to specifications of the pipe — diameter, thickness, and type of material. Meters provide a visual check to aid in controlling the welding process. While the initial weld is being made, manual removal of the slag allows the cover pass to be deposited without breaking the arc.

Contractors

Contractors for main line construction were Oklahoma Contracting Company, O. R. Burden Construction Corporation, Panama-Williams Corporation, and River Construction Company. Gathering and supply lines were laid by Lone Star Constructors, Sam Carline, Inc., H. S. Shanks and Son, The Parsons Company, Berry Construction Company, H & K Construction Company, and Altgelt Construction Company. Brown and Root made the Galveston Bay crossing, and river crossings were installed by J. Ray McDermott & Company, and Buddy Sherrod.

HOUSTON TEXAS GAS AND OIL

Besides adding up to a greater mileage of pipeline, it is quite likely a consensus would hold that contractors on the Houston end of the system encountered a greater variety of natural obstacles, although individually perhaps of no greater severity than those on Coastal's. They consisted of swamps, excessive timber, crumbling soil, a water table over a considerable part of the route that at times was within a

Clamshells and backhoes were employed extensively to clean out caving ditch and, in many instances, make the trench where soil was too spongy for conventional ditching machines.

foot of the surface, and many rivers. Swamps and marshy lowlands in particular were a severe problem. About 65 percent of the section was through this type of terrain. An extensive use of backhoes and clamshells was required to clean out caving ditch and in some instances to make ditch. It was necessary, when possible, to cradle the pipe into the ditch immediately after wrapping, as it was not advisable to leave even a limited stretch of open ditch. There were places, however, where this could not be done because of the high water level in the trench, and, in such instances, the wrapped pipe was laid on dirt pads while water was pumped from the ditch, then lowered and tied into the rest of the line.

The spongy nature of the terrain also required special handling of equipment. Welding machines for the stringer bead and hot pass welders were mounted on steel scows carried on Athey tracks. Skids, tape, wrap, water pumps, and various other equipment and supplies, were hauled in similar manner.

Despite such handicaps, each spread averaged better than 6000 ft a day rain or shine, and some spreads laid as much pipe as 10,000 ft a day.

One factor contributing largely to the speed of construction was the fact that on most of the 24-in. main line 60-ft joints were used, which enabled the contractor to reduce the number of field welds by a third, as well as speed up line-up and stringer bead welding time. This pipe was double-jointed at the manufacturer's plant by Midwestern Welding, Ltd.

Work Schedules

The 923 miles of main line were divided into six schedules for purposes of construction, and the 706 miles of laterals into several more.

Schedule 1 on the main line consisted of 146.7 miles of 24-in. from the end of the Coastal system at Quincy, Louisiana, north of Baton Rouge, to the Pascagoula River in Mississippi. This schedule was through considerable timber, possibly 70 percent, and swamps.

Schedule 2, 175.9 miles of 24-in. from Pascagoula River to the Choctawhatchee River near Chipley, Florida, has terrain similar to that of Schedule 1.

Schedule 3, 207.1 miles from Choctawhatchee River to a point near Starke, was through timber and swamps.

An accidentally damaged section of pipe is being cut from the line and will be replaced.

Pipe on the Houston Texas Gas and Oil Corporation section is protected with polyethylene tape and an outer wrap of glass mat impregnated with asphalt and mica.

Schedule 4, between Starke and Kissimmee, consisted of 151.11 miles of timber, swamps, and citrus groves.

Schedule 5, extended from Kissimmee to Riviera, 149.2 miles. The size of the pipe was reduced from 24 in. to 20 in. for the 98.9-mile section between Kissimmee and Fort Pierce, and was further reduced to 18 in. from the latter point to Riviera, a distance of 51.3 miles. The right-of-way was through cattle country, swamps, and citrus groves until it reached Fort Pierce. From that point to a few miles north of Miami the route is on the right-of-way of the Sunshine Parkway, one of Florida's beautiful turnpikes.

As this Parkway is a separate turnpike authority, created by state statute, the right-of-way procurement problem was simplified by virtue of having only one source of negotiation rather than many individual landowners to deal with. Another benefit was elimination of clearing. All was not on the plus side, however; there were disadvantages. The contractor was cramped by limited space in which to work. The line had to be laid either between the shoulder of the highway and a borrow ditch or between the ditch and the fenceline. The Turnpike Authority also has rigid regulations regarding movement of equipment, turnarounds, etc. Equipment could be moved by lowboy only if Turnpike Authority equipment was used. There were few access roads and turnarounds could be made only at specified places, which were not numerous.

Along the Sunshine Parkway the water table is particularly high and the soil sugary, requiring careful attention to the ditch, lowering-in, and backfill. There were coral deposits, too, and, as no blasting was permitted along the turnpike, the trench had to be cut with ditching machines. As a result, the mortality rate of teeth and sidecutters was high. In the sugar sand soil the ditch had to be made approximately 12 ft wide to keep it from caving.

Water that constantly filled the trench was pumped out by means of centrifugal pumps, some of which were mounted on four-wheel trucks for rapid movement from one place to another. Screw-type holddown clamps were used extensively to assist the regular backfill in keeping the pipeline in place.

Schedule 6 was from Riviera to Cutler, just south of Miami, southern terminus of the line. This 91.2-mile section of 18-in. was mostly along the Sunshine Parkway also. The last 12 miles, however, was through Metropolitan Miami, with the customary difficulties that attend construction of a pipeline through a congested area with its streets, water mains, houses, buildings, etc.

Laterals branch off at various points along the main line to serve such well known cities as St. Petersburg, Tampa, Bradenton, Sarasota, Jacksonville, Gainesville, Lakeland, Winter Haven, Orlando, to name but a few. The accompanying map shows these in detail.

A water filled ditch was not an unusual sight. In some areas, particularly in Florida, the water table was only a foot below the surface of the ground.

River Crossings

On the Houston Texas Gas and Oil portion of the transmission system 25 rivers were crossed. Five of these were aerial bridges, the rest underwater crossings. Most of the rivers were crossed with single lines, installed by the regular contractors. Exceptions were the aerial spans and eight crossings contracted and laid by special river crews.

Laying pipe alongside the Sunshine State Parkway in Florida presented some problems... limited working space, certain restrictions necessitated by steady flow of traffic, etc.... on the other hand right-of-way procurement was simplified.

Dual 18-in. lines across the Mobile River were particularly difficult to install because of a 7-mile swamp on the east side and a 2-mile swamp on the west. Each line measured 3090 ft, and to lay them a canal was dredged and the pipe string pushed into place.

On underwater crossings concrete-coated pipe was laid on the bottom of the streams, to which heavy wall (0.438 in.) pipe with weights was welded to form the rest of the river string.

Aerial spans are of the type developed in recent years that are completely prefabricated, except for the line pipe, shipped to the jobsite, and assembled on shore. Actual erection time took but a few hours for each after concrete foundations for tripods and wind anchor blocks had cured, and the towers welded up. The main towers supporting the cable system are large boxed plate columns. In their installed position, looking from the river, they resemble an upside down letter "Y". The towers are hermetically sealed with all-welded connections and will float. Advantage was taken of this buoyancy to float them across the streams in making preparations for the final raising. Erection time varied from two to six hours, depending upon interference by waterway traffic. Spans installed at the five crossings were:

Pearl River (Mississippi) .....520-ft span.
Pascagoula River (Mississippi) .....660-ft span.
Escambia River (Florida) ....640-ft span.
Apalachicola River (Florida) 960-ft span.
Suwannee River (Florida) ....660-ft span.

Line Pipe

Main line pipe was Grade X-52 API 5LX with a wall thickness of 0.312 in. In congested areas and on road, highway, and railroad crossings, wall thickness was increased to 0.375 in. On river crossings, pipe wall thickness was 0.438 in., as has been mentioned.

Testing the Line

The line was tested hydrostatically to 1100 psi, usually in 35 to 40-mile sections, although sometimes 50-mile sections were necessary.

Coating and Wrapping

Polyethylene tape was used in lieu of coating on this part of the system, and was followed by an outer wrap of glass mat impregnated with asphalt and mica. This marked the first application of polyethylene tape to big inch pipe. Previously, the maximum pipe diameter was 12 in. It was also the first time a single combined cleaning and wrapping machine was utilized. Heretofore, separate machines have been used for the two operations.

This job also registered another first in respect to tape. For the first time 18-in. tape was used, whereas the widest previously had been 15 in. The 18-in. tape was applied to the 24-in. pipe; on 18-in. pipe, 12-in. tape was used; and on 8-in. pipe, 9-in. tape. All tape was 14 mils thick — 10 mils film and 4 mils adhesive.

The wrinkle problem sometimes associated with tape wrapping was eliminated by use of spreader bars on the wrapping machines.

Welding

Houston welding requirements were the same as those for Coastal. Rigid inspection by radiographic and visual means was stressed, and applicants for welding jobs were stringently checked before being qualified.

Block Valves

To isolate sections of the line if and when necessary, valves were installed at intervals of 14 to 20 miles, depending upon accessibility. Block valves also were installed on the dual Mobile River crossing, but not on other river crossings.

Communications

Communications in the form of teletype and telemetering are provided over leased wire. In addition, VHF short

"Jeeping" the line for holidays after it has been taped and wrapped.

Backfilling the ditch along the Sunshine Parkway in Florida.

wave radio connects each compressor station to mobile units in the field.

Contractors

Midwestern-Walco Constructors and Harbert Construction Corporation laid this section of the system. The latter subcontracted a part of its work to Mid-States Construction Corporation. Panama, Inc., contracted eight underwater river crossings, and Clear Span Engineering Company made the five aerial crossings. Barnard and Burk Pipeline Engineering, Inc., engineered the system, and supervised construction and inspection.

Cathodic Protection System

To test for holidays after the ditch was backfilled, Pearson Holiday Surveys were made by Cathodic Protection Service on three 35-mile sections of the 24-in. main line. The surveys were made about two months after the lines had been laid, and in the meantime they had received soaking rains.

Results were 21 holidays found per mile on the worst section and eight on the best. Most of the holidays occurred at the edges of swamps. In many instances no holidays were found for several miles.

Coating resistances averaged well over 1,000,000 ohms per sq ft for all three sections. These data were obtained shortly after the lines were laid, but several months later some of the resistances were rechecked and had not changed perceptibly.

This rechecking was done as a part of a preliminary survey, now complete, to obtain basic information necessary to design a cathodic protection system, which is being installed by this same company.

The cathodic protection system will be unusual in several respects. This will be the longest section of polyethylene taped pipe to which cathodic protection has been applied. A novel problem results from the fact that the pipeline traverses long stretches of extremely high resistivity soils, making it impossible to use groundbeds of resistances low enough that power costs will not be excessive and at the same time current will be sufficient to provide adequate protection. Consequently, a high percentage of deep well type vertical groundbeds are being installed. This procedure calls for drilling holes by water well drilling methods to depths of several hundred feet to locate strata of clay or water-bearing formations in order to obtain satisfactorily low groundbed resistance. This method of construction is more costly initially, but the payout is quick in terms of power consumption.

Compressor Stations

Four compressor stations having a combined horsepower of 16,500 were installed on the Coastal system. The first station is at Robstown, Texas, about 115 miles from the origin of the pipeline. Up to this point gas is boosted by wellhead pressure. Robstown has a single 2500-hp, 10-cylinder compressor unit, but in succeeding stations the horsepower becomes increasingly greater as new volumes of gas are taken into the line along the way.

The second station at Bay City has two 2000-hp, 8-cylinder units, the third station at Beaumont the same, but at Baton Rouge, Louisiana, the station that delivers gas to the Houston Texas Gas and Oil Corporation, there are three 2000-hp, 8-cylinder units.

Coastal's compressor units are all of the conventional 2-cycle angle type. They are not turbocharged but are designed for turbocharging to be added later when additional pumping power is needed. Turbocharging would increase each rated horsepower by 40 percent. At present each unit has a centrifugal blower, gear-driven off the crankshaft, which supplies scavenging air. When turbocharged another blower will be added in series with the gear-driven blower but it will be driven by exhaust gas.

Air for starting the compressor engines is provided by a gas engine driven compressor.

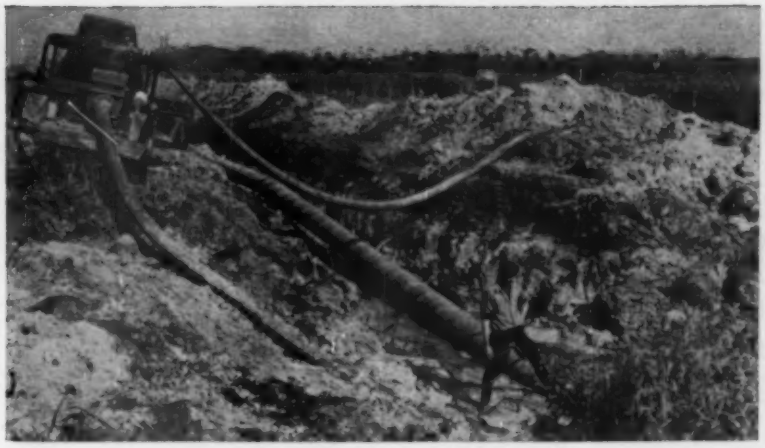
Each station has an inlet gas scrubber and a fuel gas scrubber. Dehydration facilities have been provided as they are needed.

Houston also has installed four compressor stations, at Wiggins, Mississippi, Munson, Quincy, and Brooker, Florida. At each of these stations there are three 2000-hp compressor units. These are supercharged 4-cycle engines driving horizontal pancake compressors. The engines were designed specifically to meet unusual requirements of this section of the system. They can operate at full and overload capacities with ambient air temperatures up to 105 F.

An unique method of driving all auxiliaries off the compressors has been designed into Houston and Coastal stations. Each engine has its own jacket water pump and individual lube oil and jacket water cooler. The jacket water pump is belt-driven off the engine and discharges through a centrifu-

Concrete-coated pipe was used in river crossings and some of the swampy areas. Here, pipe is being strung near Perry, Florida.

Ditching machine is making good progress at this point where terrain is favorable.



Pumping water from ditch before lowering and backfilling. This was not an unusual scene.

gal pump running backward, which drives the fan that cools the jacket water and lube oil. The only power needed otherwise is for station lighting and personnel housing.

Stations will be attended and are designed for local starting. Each engine is unitized, having its individual panel board, start-up and loading equipment, etc. The panel board contains recorder-controllers and indicators to inform the operator of pressures, speed, and temperatures.

Also on the engine panel boards are the shutdown devices for low engine oil pressure, high jacket water temperature, and engine overspeed. These are tied into the indicators so the operator will know the cause of an engine shutdown.

A manually operated valve on the panel board actuates suction, discharge, and bypass valves for loading the engine, and a master valve is provided that will operate each of these valves in proper sequence for loading or unloading.

In addition to the individual engine panel boards, each station has a master panel board that contains recorders for suction and discharge pressures, and suction and discharge temperatures for the entire station.

Block valves on the station inlet are tied into the emergency shutdown system and to the emergency relief valves. The latter, besides serving in a relief capacity, also operate as emergency blowdown valves.

A pig launcher was installed at the Robstown station on the Coastal end of the system, a receiver and launcher at Bay City and Beaumont, and a receiver only at Baton Rouge. There will be no pigging on the Houston end of the line, as no gas will be picked up beyond Baton Rouge and it is considered that the gas will be completely clean by the time it leaves that station.

Houston stations were designed by Barnard and Burk Pipeline Engineering, Inc.; three were built by Midwestern-Walco Constructors; and one by Harbert Construction Corporation.

Coastal stations at Robstown and Bay City were constructed by Gasoline Plant Construction Company, the Beaumont station by The Early Company, and the Baton Rouge station by Tuloma Builders.

FUTURE PLANS FOR EXPANSION

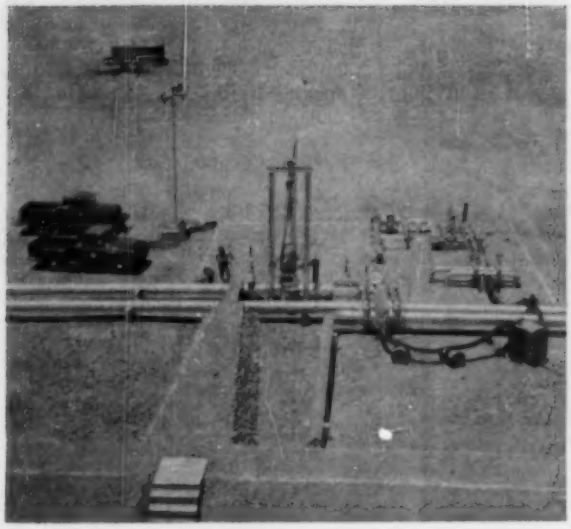
The Texas-to-Florida pipeline system was designed with a view to future expansion. Subject to FPC approval, it is expected that by the middle of 1960, seven more compressor stations will be added, increasing delivery capacity to 335,000,000 cu ft a day. Estimated cost of the stations and necessary service and supply laterals is $18,000,000. The system as it stands today cost $164,000,000 plus. Coastal filed its application for such an expansion with FPC on April 21.

Future expansion is predicated on market surveys and experience of Houston Texas Gas and Oil Corporation in contracting for the sale of gas, which reveal there is a demand for industrial gas in Florida exceeding the volume that can be made available at the present time. It is expected, also, that with continued industrial development of Florida, there will be a further increase in this demand, as well as in demand for gas to generate electric energy. Additionally, it is expected that the resale customers of Houston Texas, including the company owned distribution systems, will expand their operations to serve more of the fuel requirements of their franchise territories than had been economically feasible with the high cost of manufactured gas.

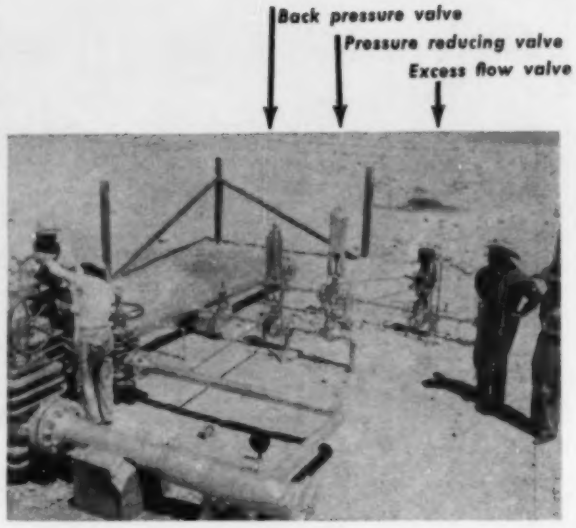
Coastal, to keep step with this proposed expansion, expects to obtain additional gas from other fields in the Gulf Coast areas of Texas and Louisiana, and from development of additional reserves in fields from which it is now taking gas. ★ ★ ★

Suction and discharge lines at one of the Florida compressor stations showing two automatic emergency blow-down valves and main block valve and suction valve.

Water storage tank, lubricating oil storage tank, aftercooler, and jacket water piping at one of the compressor stations.



Arica terminal. View from top of tank looking down on receiving and distribution manifold during transfer of salt water from one tank to another.



San Martin pressure reducing station (No. 3) showing four representatives of YPFB present during initial operation of station.

Hydraulic Testing Becomes Complex at High Altitudes

These procedures were used on Bolivian pipeline system, which drops sharply from an altitude of 14,531 ft to sea level

E. E. Mincheff, *Senior Engineer, Williams Brothers Company*

THE RECENT 215-mile extension of the Bolivian pipeline system from Sicasica, Bolivia, to Arica, Chile, called for the resolution of many unusual design, construction, and testing problems. These problems were generated primarily by two unusual conditions of the terrain. The pipeline extends 185 miles across the Bolivian Alto Plano, a high plateau in north central Bolivia, most of which is at an elevation exceeding 12,300 ft. It also crosses the Andean Mountains at an elevation of 14,531 ft, from which it descends sharply to sea level.

The extension designed and built by Williams Brothers Company is the final link in the transportation of crude oil destined for export from the Camiri fields in south central Bolivia to the Pacific Ocean Port of Arica.

Sicasica pump station (elevation 12,813 ft) will move the initial design capacity of 7000 bbl per day to Arica, 215 miles distant. Three pressure control stations are located at points on the steep downward slope of the main line and a fourth at the terminal in Arica, Chile. These pressure control stations reduce the potential 4970-psi static pressure into increments below maximum allowable pressures in each section of the pipeline during operating or shutdown conditions.

The terminal in Arica, Chili, includes a pressure reducing station, four floating roof tanks totaling 300,000 bbl of storage, and an offshore marine loading system complete with ballast water handling and oil separation facilities. Here the crude oil will be loaded aboard tankers through a submarine sea loading line extending three miles from the terminal to an offshore sea berth.

The first 171 miles of the mainline is 10¾-in. OD, 0.279-in. wall pipe. The remaining 44 miles is 8⅝-in. OD, 0.250-in. wall pipe. The route of the new system is shown in Fig. 1.

INTERNATIONAL
PIPELINING

Preliminary Preparations

Each joint of pipe was hydrostatically tested at the mill prior to shipment; the 10 in. at 1860 psi and the 8 in. at 1830 psi. The entire pipeline system was also hydrostatically tested in place in accordance with Construction Specifications.

Hydraulic testing and the relatively

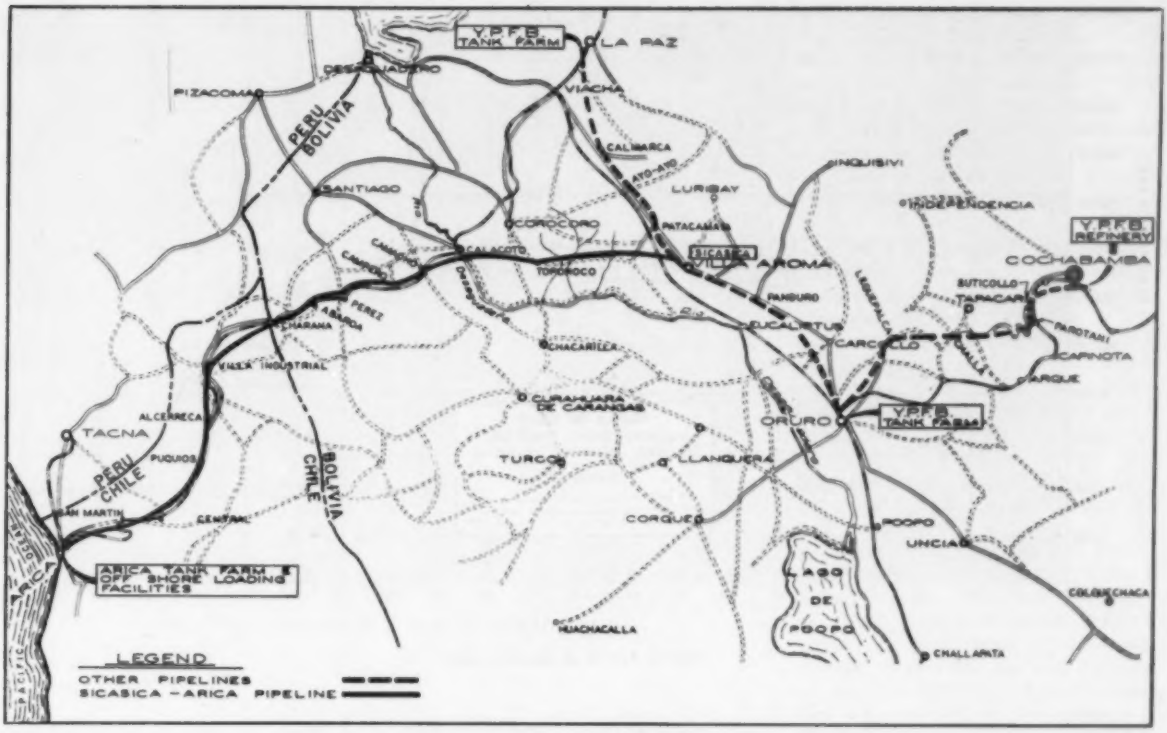


FIG. 1. Route of the new pipeline from Sicasica, Bolivia, to Arica, Chile.

simple problem of filling a line can become quite complex in high altitude systems.

The test and fill program was further complicated by the scarcity of water along the entire traverse of the pipeline, as well as at its origin. Water for line fill was finally obtained from the Rio Desaguadero about 60 miles downstream along the route of the new line. This was accomplished by removing one of the two reciprocating pump units at the Sicasica station, and combining the pump and engine unit on a lowboy.

The engine and pump required certain modifications. Alterations to the engine consisted of adding a radiator assembly and cooling fan. The pump had to generate higher pressures, as well as handle abrasives while pumping river water. So a set of slush pump rods, pistons, liners, valves, and packing glands was supplied to the test crew. The entire assembly was then moved from Sicasica to the Rio Desaguadero and installed as schematically shown in Fig. 3.

Four test locations. Four test locations were established though the line was divided into five test sections. The first test location was used to test the sections on either side of it. Test locations and local test pressures are tabulated as:

Station	Gate valve number	Test pressure
A	5	1630 psi both sides of Gate Valve No. 5
B	PRS #2	1720 psi
C	PRS #3	1960 psi
D	Arica	1560 psi

For testing and filling purposes, the 10-in line was divided into two sections and the 8-in. into three sections as:

Section 1. Sicasica to Gate Valve No. 5.
Section 2. Gate Valve No. 4 to Pressure Reducing Station No. 1.
Section 3. Pressure Reducing Station No. 1 to Pressure Reducing Station No. 2.
Section 4. Pressure Reducing Station No. 2 to Pressure Reducing Station No. 3.
Section 5. Pressure Reducing Station No. 3 to Arica.

Each section of the 10-in. line was tested at a pressure that would provide the equivalent of 1500 psi at Sicasica, as illustrated by Fig. 2. Test pressure and liquid temperature were recorded on a continuous chart and, in addition, ambient temperature was recorded at 15-min intervals during the test period.

Strainer upstream. A field fabricated strainer was placed upstream of the pipeline crossing in a deep but quiet portion of the river to minimize the intake of solids into the pump unit. A 6-in. suction hose was led to a 90,000-gal-per-hr engine driven centrifugal pump that boosted the water into the inlet of the reciprocating pump. A weight load relief valve was placed on the reciprocating pump discharge to protect the pump and related connections.

Filling 10-in. Sections

With Gate Valve No. 5 closed, the filling procedure was started and water was pumped toward Sicasica. Because the water was exceptionally clean and because the original 5-in. liners in the unit would pump 300 bbl per hr versus 200 bbl per hr for the smaller 4-in. liners, initial pumping was started without substituting the smaller slush pump conversion kit.

Pumping was continuous until the line pressure reached 745 psi, at which time the V-belt drive started to slip. The unit was stopped and the 4-in. slush pump conversion kit installed in the pump. As is usual during field operations, this change-out became necessary late one evening and was completed at 2:00 in the morning. Pumping operations were resumed and continued until water arrived at Sicasica. The first portion of the water received at Sicasica was discharged through the scraper trap to natural drainage until it had flushed the solids from the line.

The Sicasica gate valve was then closed. The air vent installed at the highest point in the line was opened to make sure all air was vented. Continuous flow of water from the vent indicated that the line was full so the pumps at the river were stopped.

Pressure gage froze. An interesting

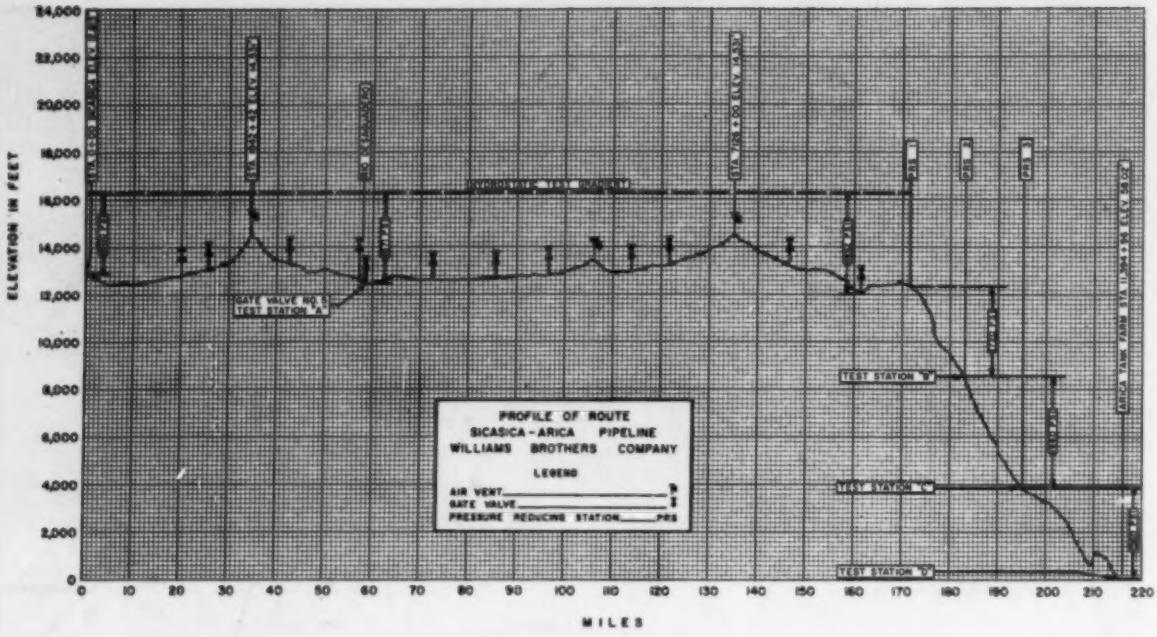


FIG. 2. Profile of pipeline route.

experience occurred on the third day of the filling operation. The indicating pressure gage installed in a blind tee off of the pump discharge piping failed to follow the calculated pressure-volume-time relationship. For several hours the pointer jiggled on the gage without reflecting a pressure increase. During this interval review of calculations and examination of equipment failed to provide a solution to baffled test personnel. Finally concern about rupture or an open line was eliminated when a spare gage was installed as a final check on operations prior to initiating line walking action. The original gage was found to contain solid ice. Following this discovery, precautions were then taken to insure that a repeat situation did not occur by the simple act of alternating the two gages and keeping the alternate in a heated vehicle between readings.

The initial pipeline fill and test procedure was predicated on obtaining 38,000 bbl of water from the Rio Desaguadero. Then the water was to be displaced from one test section into the next test section with product pumped to Sicasica from Cochabamba through an existing system. Due to conflicts in pumping schedules, however, it became necessary to pump an additional 30,000 bbl of water from the Rio Desaguadero into the line to expedite the fill and test program.

When the test on the first section of 10-in. line had been completed, and the additional 30,000 bbl of water had been added, the water in the pipeline was displaced toward Arica with product from Cochabamba, Bolivia. The second of two pumping units at Sicasica was used to relay the product stream to Arica as it was received from Cochabamba.

Testing 10-in. Sections

When the line fill operation was complete, the first test section was set up on the Sicasica side of Gate Valve No. 5, as schematically shown in Fig. 4. When all connections to and from the air-driven piston pump had been completed and checked, it was started. Air at 110 psi was supplied by an engine-driven air compressor. The piston pump was rated to deliver 16 gal per min at 2000 psi. Actually, the maximum pressure required was 1630 psi. Ambient temperatures were taken at 15-min intervals and recorded in a note book. The pressure recorder was calibrated with a dead-weight tester.

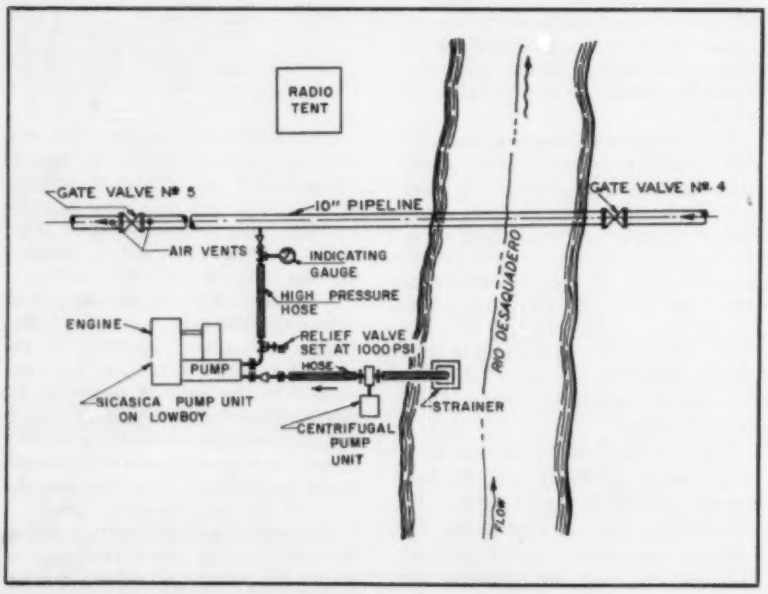


FIG. 3. Pump connections at Rio Desaquadero for filling line.

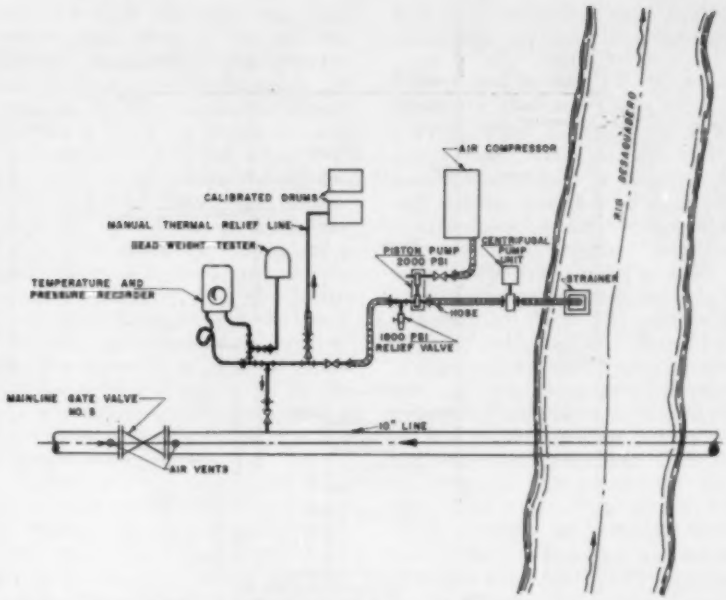


FIG. 4. Piping schematic for pressure testing 10-in. line.

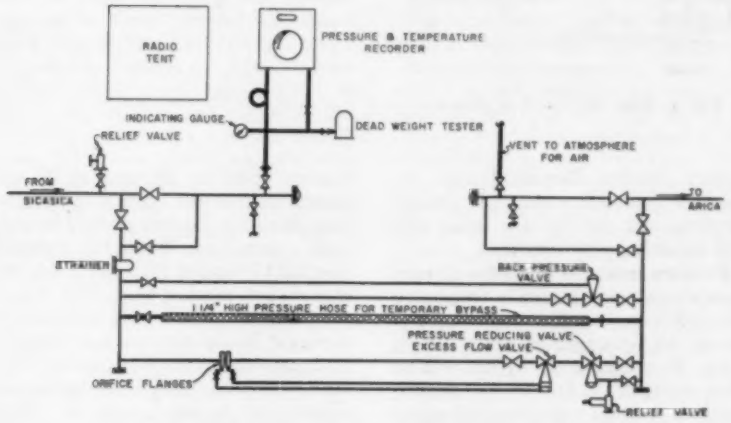


FIG. 5. Typical pressure reducing station testing hookup.

The recording instrument also was equipped with a temperature element to record temperature in the pipeline at the test station.

Ambient temperature affects pressure. The complexities of hydrostatically testing this pipeline were further aggravated by the fact that substantial portions of it were subjected to the direct effects of ambient temperature variations with resultant changes in the internal pressure. Accordingly, provisions were made to measure the quantity of water that would have to be added or removed to maintain a constant test pressure. The actual test period on the first section occurred during a rising temperature cycle, resulting in the removal of 1028 gal of water. The first section tested was 60 miles in length and test results were satisfactory.

After completion of the test in the first section, the pump unit at the Rio Desaguadero resumed pumping water, until an additional 30,000 bbl were added to the line fill. The test pressure in the first section was relieved after testing through Gate Valve No. 5 into the next section so as to take advantage of every conceivable gallon of water added to the line.

Prior to completing the water fill program, a 32,000-bbl shipment of product was scheduled into Sicasica from Cochabamba. As the shipment arrived, it was diverted into the 10-in. line, using the one remaining reciprocating pump unit installed at Sicasica. A 10-in. rubber batching pig was inserted in the scraper trap and it was dispatched at the head end of the product column to act as a separator between product and water. When product arrived at Gate Valve No. 4 and the batching pig had passed beyond the valve, the line was shutdown and the odd volume remaining of the shipment was put into the 2000-bbl relief tank at Sicasica.

Compensating for thermal expansion. Pipeline relief valves at Sicasica station isolated during the test, were reactivated during the product movement to relieve thermal expansion through them while the next pipeline section was under test. Thermal expansion can cause serious consequences if not compensated for during a test program. On this pipeline it was of crucial importance because of the large temperature changes resulting from effects of the sun on long sections of exposed pipe.

The fill and test procedure also had to provide for the fact that any product-water interface must be stopped on a downhill slope with the light product on top in order to maintain the correct relative position of the two liquids during non-flow periods.

With completion of the pumping operation at Sicasica, the test equipment was again set at Gate Valve No. 5 and the second section of the 10-in. line from Gate Valve No. 4 to Pressure Reducing Station No. 1 was put under test at 1630 psi. Again the line section tested was found to be intact. Upon completion of the test, the pumping unit at the Rio Desaguadero was returned to and installed in the Sicasica station.

E. E. Mincheff, *Senior Engineer, Williams Brothers Company of Tulsa, received a Bachelor of Science degree in mechanical engineering from the University of Kansas in 1949. A registered professional engineer in the states of Missouri, Florida, Illinois, and Oklahoma, he is also an active participant in the activities of the transportation divisions of the API and ASME. Mincheff spent two and a half years as design engineer for Bendix Aviation Corporation and six years as assistant to the chief engineer for the Great Lakes Pipe Line Company before joining Williams Brothers Company in 1957.*

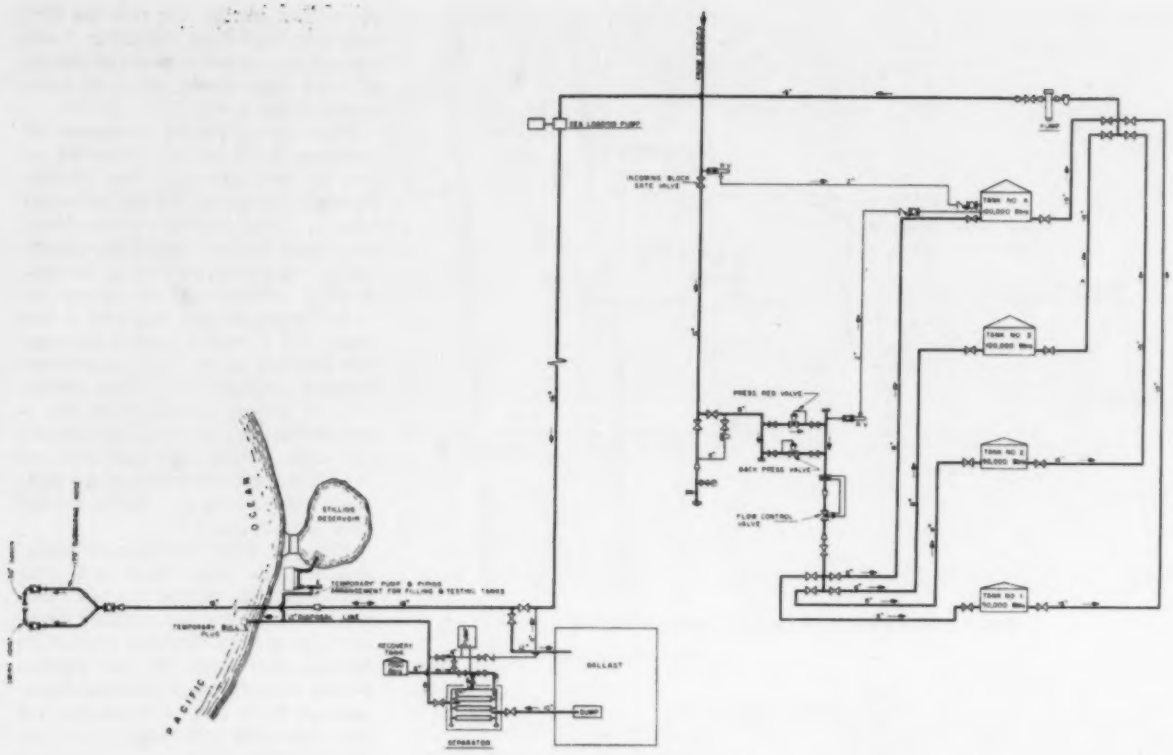


FIG. 6. Arica terminal flow diagram.

8-in. Sections Filled by Gravity

At this stage the test and fill procedure departed completely from normal. The remaining pipe sections, totaling 44 miles of 8-in. line, were filled strictly by gravity. Water from the 10-in. line was drained into the first section, then successively to each of the lower sections after testing the section containing the water. Test pressures were generated by static head alone. The problem here was to restrict flow rate and to limit pressure to test valves, thereby completely reversing the usual problem of generating high pressures at reasonable flow rates.

Maximum pressure in any one section was 1960 psi with water versus 1488 psi static pressure for corresponding crude oil fill. This pressure created entirely by static head subjected a few miles of pipe to a maximum of 130 psi above mill test pressure.

Because the static pressure would be sustained at high values in the event of rupture, until the line had drained, it was essential that certain precautions be observed to reduce potential hazards to test personnel, as well as to the pipeline. During the entire fill and test operation, portable radio communications were a must, but during this portion of the test communications were essential between the upstream and downstream station so as not to rupture the line. Personnel were advised to approach valves and fittings carefully and not be in a direct line with possible gasket blowouts.

Pressure regulated carefully. At each pressure reducing station a temporary bypass line was installed consisting of a 1¼-in. high-pressure hose and a plug valve. This temporary bypass was to allow filling of the line without passing water through the station control equipment until clean water could be assured at a pressure low enough to be within the control range. The filling operation was critical in that pressure had to be regulated carefully to push an 8-in. rubber batching pig through each section to clear the line, and to prevent line rupture.

With the air vent open at the highest portion of the 10-in. line water was drained into the first 8-in. section from the 10-in. line. When the pig was received at Pressure Reducing Station No. 2, it was removed and water was diverted to natural drainage until it had flushed the deposits of dirt, slag, or other solids out of the line and was flowing relatively clean. Valves at the lower end of the first 8-in. section were then closed, and the test personnel in attendance proceeded to observe the pressure build-up in the line on the installed pressure recorder and indicating pressure gage. When the pressure reached 1500 psi, the man at the upstream station was advised to throttle flow through the temporary bypass hose connection. When the pressure reached 1720 psi at PRS No. 2, the line was shutoff completely at PRS No. 1. At that point the air vent, provided by removal of the downstream scraper trap pressure gage, was opened wide to accommodate thermal expansion and contraction. It also served as a final visual indication that the lower line section was full by spouting a continuous stream of water prior to bypass valve closure.

Testing 8-in. Line

The 8-in. pipeline test station was set up as schematically shown in Fig. 5. At the signal from the man at PRS No. 1 that the line was completely full, the test was begun. The same data were recorded at this test site as at Gate Valve No. 5, and the test period was identical in length.

The first 8-in. section was found to be completely free from leaks. Upon completion of the test period, the water was drained into the next and lower section. Additional water was admitted from upstream until the section between PRS No. 2 and 3 was filled. It was tested in a like manner.

The hydraulic test in this second section of the 8-in. line introduced an

item of interest, illustrating that occasionally laminations in the pipe that will fail under operating conditions can withstand sustained hydrostatic test pressures. In the pipe section between PRS No. 2 and 3, the maximum pressure upstream of PRS No. 3 was 1960 psi, which was maintained for the full duration of the test period on November 9 and 10. Two minor leaks were found in the entire test section, one a small seep in an exposed weld, and the second a split about 1-in. long in the pipe, about 3000 ft upstream from PRS No. 3, at a point where the pressure was estimated at 1920 psi. Upon completion of the test, water in the pipe was drained into the lower section and repairs were effected on the two leaks.

On November 22, the pressure in the same section was raised to a maximum of 1650 psi during transfer of additional water into the lowest 8-in. section. In the same joint of pipe that had previously sustained 1920 psi, but 15 ft downstream of the previous repair, a second blowout occurred. It was also about 1-in. long. The line was again drained into the lower section and upon investigation the joint was found to contain a series of discontinuous laminations for a distance of 15 ft. A 20 ft pipe section encompassing the old and new leak was replaced, whereupon the line remained intact during subsequent operation.

When the test on the second section of 8-in. line was completed, the fill procedure was started on the last section extending into Arica. The batching pig was pushed into the Arica scraper trap and removed, after which the water column built up a static head of 817 psi. At this pressure an imperfect gasket on the upstream side of the Arica terminal incoming block valve failed and a main line loss of about 1000 bbl of water occurred before the gasket could be replaced. Although there was no quick way to relieve the static pressure, it was hastened by receiving the line fill of water into one of the storage tanks at Arica.

The gasket was replaced, but the 1000-bbl line loss left insufficient volume in upstream sections to completely fill the last section. Therefore, it became necessary to reschedule a 10,000-bbl shipment of product to Sicasica. The additional product forced an equivalent volume of water over the high point in the line where it gravitated down to supply volume needed to fill the last section.

During the filling operation of each section, the pressure reducing station controls were all set, adjusted, and checked with flowing water. The line fill of fresh water was then drained into Arica where it was used to flush the interior of the tanks, which had been tested with salt water from the ocean.

Filling and Testing Terminal Tankage

Fresh water at Arica, Chile, is a scarce item. Some concept can be gained by checking the weather records, which show that no measurable rainfall has occurred during the last 16 years. Local domestic fresh water requirements are supplied by wells.

At Arica the construction schedule was such that the tankage and the sea loading facility had to be tested prior to scheduled arrival of fresh water from the main line. A complete hydrostatic and operational test on the two 50,000-bbl and two 100,000-bbl floating roof tanks required a minimum of 120,000 bbl of water. This amount was more than local wells could supply. The Pacific Ocean is approximately 13,000 ft from the terminal, so it was decided to use sea water for hydrostatic testing. At the terminal the bottom elevation of the lowest tank is 125 ft above sea level.

Using the ocean. The 125-ft static head exceeded the maximum discharge head of all available pumps, except the reciprocating pump installed at the ballast water facilities. This unit, capable of pumping 162 bbl per hr at existing conditions, was moved to the mouth of the dry San Jose River. Here a dozer was used to dig a large stilling reservoir in the dry river bed with adequate capacity to permit continuous operation of the pump during the interval between high tides. The seaward side of the stilling reservoir was graded to an elevation about 1 ft below high tide level to allow the high tide to fill the reservoir. As the tide receded, the reservoir retained the volume of water necessary for continuous pumping.

A field fabricated strainer of wire mesh was placed over the submerged suction line to the pump to prevent rocks, sand, or other solids from entering the pump and damaging it. The discharge from the pump was connected into the 12 in. diam ballast disposal line between the ballast water handling facilities and the ocean, as shown in Fig. 6. The ocean end of the ballast line was bull plugged. The water was pumped up the 12-in. line to the ballast water area where it passed through the manifold and was diverted into the 18-in. tanker loading line leading to the terminal. At the terminal the water was directed into one of the 100,000-bbl tanks for testing the tank bottom and the pontoon of the floating roof.

When sufficient water had entered the first tank to float the roof off the bottom, the water stream was diverted into a second tank. Each of the roofs in the four tanks were floated in this manner. The incoming water was then directed back into the first tank, which was filled to the top in order to check the free rise of the roof. Chipping of welds on the inside of the tank shells was accomplished by using the floating roof as a platform as the incoming water raised it in the tank.

When the first 100,000-bbl tank was completely tested, the water was transferred to the second 100,000-bbl tank through temporary connections at the suction and fill manifolds and the use of a 90,000 gal per hr engine-driven centrifugal pump. The two 50,000-bbl tanks were tested and filled in a like manner.

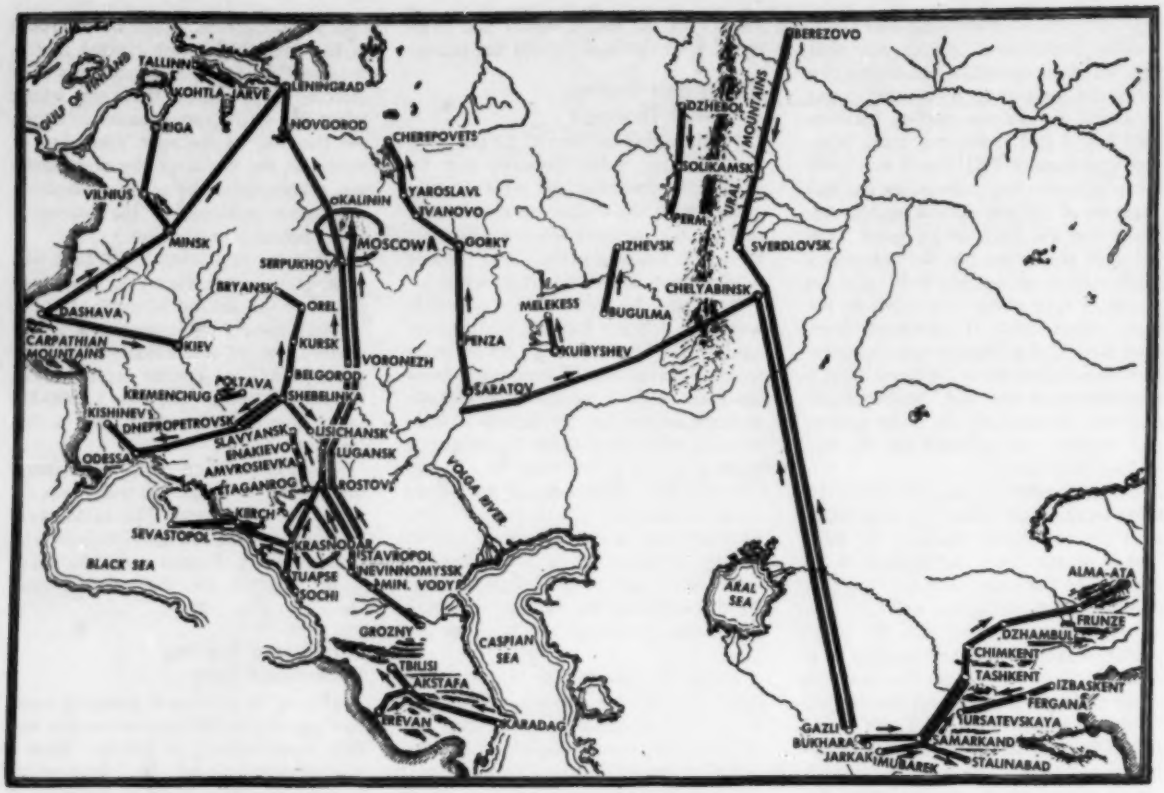
Upon completion of the hydrostatic test of the tanks, the sea water was returned to the ocean. The tanks were pumped dry and the interior shells and bottoms were flushed with the fresh water received into the terminal from the main line.

Filling and Testing Submarine Line

During the process of pumping water to the tanks, the submarine sea line was first tested with air at 100 psi. Then it was subjected to a 275-psi hydrostatic test in place. The submerged portion of the sea line was filled with water by opening the valves at the outer end of the sea loading hoses and allowing water to flow in through the hoses. Then the valves were closed and the 18-in. valve at the ballast water manifold was opened to fill the land portion of the line down to the water's edge with water from tankage at the terminal.

Connections were left open for 24 hours to give any air trapped in the lower portion of the line a chance to move up toward the ballast manifold where it could be vented off. A 1500-bbl cone roof tank in the ballast water area was filled with sea water and used as a reservoir from which the air driven high pressure piston pump used on the main line test took suction. When all the air had been removed the hydrostatic test was applied and the line was found to be intact. Upon completion of the test, the salt water was drained to the ocean.

Careful analysis of the technical data recorded during the entire test program failed to produce any significant correlation between temperature, pressure, and volume changes. Complete data necessary for a laboratory type analysis cannot be economically obtained during field hydrostatic test programs. As in many similar situations, the experience and judgment of the testing personnel in evaluation of final results is of far greater importance than detailed analysis of recorded data. ★ ★ ★



Pipelines that Russia plans to construct from 1959 to 1965. Arrows show direction of gas flow.

Russia Revises Pipeline Goals

New Seven-Year Plan (1959-65) calls for 34,775 miles of pipeline construction reaching beyond its national borders to satellite countries and possibly Finland and Sweden

Charles L. Adams

RUSSIA hopes to use a burgeoning network of oil and gas pipelines to weld together a vast, interdependent economic empire reaching far beyond its national borders.

When the Soviet Union scrapped its Sixth Five-Year Plan (1956-1960) and replaced it last fall with a Seven-Year Plan (1959-1965), implications of its revised pipelining program were not immediately apparent. Propaganda emphasis continued to be placed entirely on projects designed to meet domestic needs.

But it is now plain that the USSR intends to pipe large quantities of oil and gas to its European satellites and possibly even to Finland and Sweden. Furthermore, pipelines originating in the "Second Baku" area between the Volga River and Ural Mountains will bring a flood of crude to Soviet refineries now under construction in western Russia.

From western Russia, refined products can easily be delivered to Baltic Sea ports for export throughout the world.

The USSR's urgent need for a greatly-expanded oil and gas pipeline system is readily apparent. Even during 1958, when crude production was only 113,000,000 metric tons[1], and gas output was 29.8 billion cu m[2], Soviet officials complained of pipeline bottlenecks.

The newspaper *Sovetskaya Rossiya* admits, for example, that the two large refineries at Kuibyshev on the Volga River suffered "constant shortages of crude" for years despite the fact that they are located close to some of the richest oil fields in the "Second Baku" region. It wasn't until late in 1958 that a 66-mile pipeline was completed from the huge Mukhanovo field to Kuibyshev to relieve these shortages.

Inadequate crude deliveries caused by delays in building pipelines and pumping stations also have plagued the new Omsk refinery in western Siberia.

Without extensive new pipeline facilities, Russia would have to cut back its goals of producing 230-240,000,000 metric tons of crude and 150 billion cu

INTERNATIONAL PIPELINING

[1] 1 ton equals 7.454 bbl (36 deg API).
[2] 1 cu m equals 35.314 cu ft.
[3] 1 kilometer equals 0.62137 mile.

m of gas in 1965. Besides tying the satellites closer to the Soviet Union, construction of crude pipelines to eastern European Communist nations would assure Russia a reliable market for much of the oil surplus likely to develop in the USSR during the early 1960s.

Biggest obstacle in the way of Soviet pipelining plans for the seven-year period from 1959 through 1965 is a shortage of pipe. The USSR is confident that this problem will be alleviated by pipe imports from non-Communist nations.

Pipelines to Satellite Countries

Complete details of Russia's pipeline penetration into the European satellites have not been disclosed in the Soviet press. However, satellite leaders, Russian officials traveling abroad, and western visitors to the USSR have provided significant scraps of information.

Last July, East German Communist party chief Walter Ulbricht declared that a major crude oil pipeline linking Russia and her European satellites was scheduled for construction in the early 1960s. Based on this project, a large new East German refinery is scheduled to be built, and imports of Russian crude will rise from 1,500,000 metric tons in 1958 to 4,800,000 metric tons by 1965.

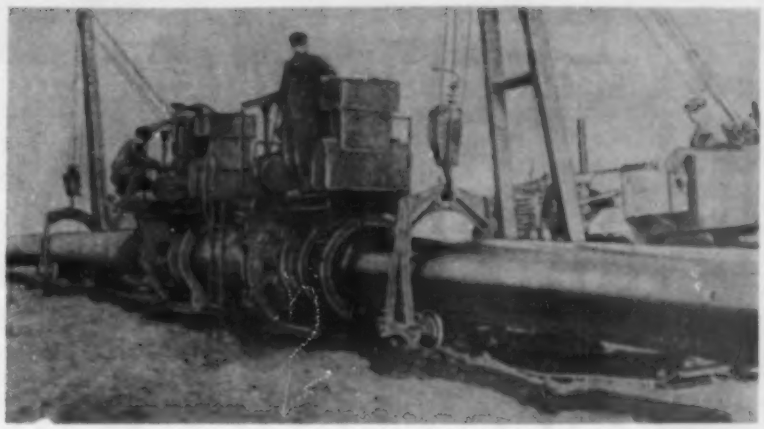
During a visit to Poland last December, Anastas I. Mikoyan, the USSR's first deputy premier, officially confirmed that a "gigantic" pipeline would be laid from the banks of the Volga River to supply Poland and other eastern European countries with "millions of tons of oil per year." He indicated the pipeline would link the "Second Baku" fields with both Poland and East Germany, possibly with branches to Czechoslovakia and Hungary.

Total length of this one pipeline system as approved by the Soviet bloc's Council for Mutual Economic Aid (Comecon) may approach 2000 miles. Annual capacity has been placed at about 5,000,000 metric tons. Cost will be shared by Russia and the participating satellite nations.

Both Poland and East Germany have become increasingly dependent on rail-transported Russian oil during recent years. In 1958, about 90 percent of Poland's crude and refined products imports came from the USSR.

The new satellite pipelines, which could easily be shut off in the event of a Soviet dispute with Poland or East Germany, will provide Moscow with enormous additional power for economic coercion over these countries.

The USSR's captive Baltic republics — Latvia, Lithuania, and Estonia — and the Russian city of Leningrad will become focal points for Soviet gas (and perhaps oil) pipelining during the Seven-Year Plan.



Cleaning and priming a crude oil pipeline in western Siberia.

Gas Line to Latvia

A natural gas line is already under construction from the western Ukraine's Carpathian fields to Riga, Latvia, via Minsk and Vilnius, Lithuania. It will provide Latvia with 200,000,000 cu m of gas in 1961 and 1.2 billion cu m in 1965.

The same system will be extended from Minsk to Leningrad on the Gulf of Finland. A shale gas pipeline will run from Kohtla-Jarve to Tallinn, Estonia, which is also on the Gulf of Finland.

There have been reports that Russia has offered Finland and Sweden some of the natural gas to be delivered from the western Ukraine. Shale gas could also be made available.

Helsinki is only 50 miles across the Gulf of Finland from Tallinn. Soviet officials have suggested that an underwater pipeline could be laid to the Finnish capital.

Short Lines to Baltic Coast

Russian crude and refined products could be brought to the Baltic coast area through comparatively short extensions of pipelines now being built. Construction of a large refinery is under way at Polotsk in Byelorussia (White Russia). This plant, to be served by crude oil pipeline from the "Second Baku" fields, is only about 200 miles from Riga.

According to official Moscow dispatches, Latvia is building up its tanker fleet in expectation of soaring Russian oil exports to northern Europe in the 1960s. By 1965, "more than half" of all cargo carried by the Latvian merchant fleet is to consist of oil and oil products destined for Scandinavia and other nearby countries.

Ports at Klaipeda, Lithuania, and Ventspils, Latvia, are being improved to permit their use by larger tankers. Klaipeda has been mentioned as a possible terminus for a crude line from the "Second Baku" region to the Baltic Sea.

Line to Black Sea Possible

Russian crude and refined products may also flow onto the world market via a new pipeline to the Black Sea. Although not officially announced as part of the Seven-Year Plan, there have been reports of a pipeline project from Stalingrad, site of a large new refinery processing "Second Baku" oil, to the Black Sea port of Tuapse.

At present, most of Russia's exported crude is produced in the original Baku fields on the Caspian Sea. From there it moves by pipeline to Batumi on the Black Sea coast, where it is loaded aboard tankers bound through the Bosporus to the Mediterranean Sea and beyond.

34,775 Miles in Seven Years

Total Russian oil and refined products pipeline construction under the Seven-Year Plan is set at 30,000 km (18,630 miles). New gas transmission lines will aggregate 26,000 km (16,146 miles).

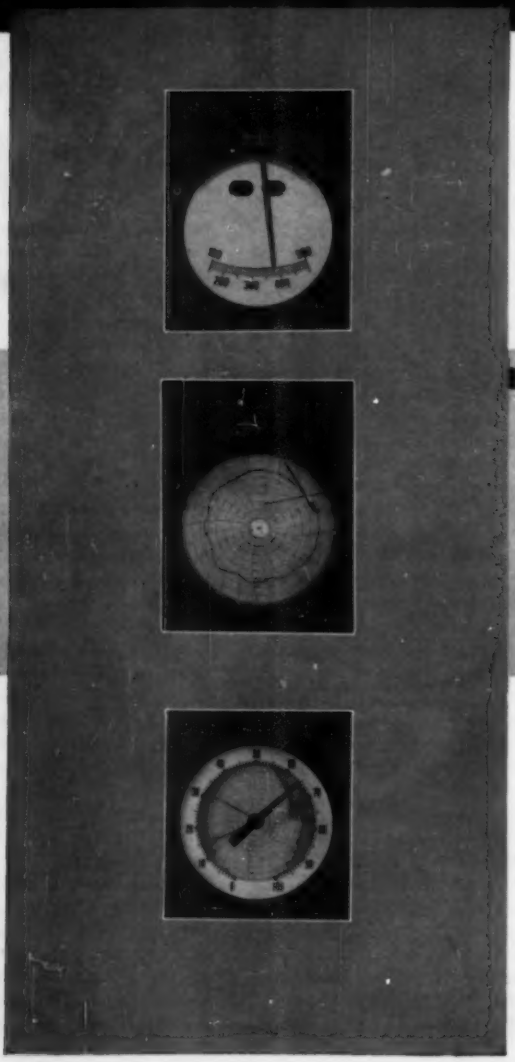
By American standards, the Soviet pipeline construction program seems unimpressive. But the Russians are starting practically from scratch.

In 1950 the USSR had less than 3200 miles of trunk pipelines for oil and refined products. By the end of 1955 there were 4600 miles of crude and 1900 miles of products lines in the USSR.

Total Russian crude and refined products pipeline mileage passed 8000 early in 1958, compared to around 200,000 miles for the United States. By the end of 1960, the USSR plans to have close to 10,000 miles of crude and 4500 miles of products lines.

Improve pipeline efficiency with the

new Honeywell Dur-O-Pulse telemetering system



Your choice of transmitters

Eccentric scale indicating transmitter
Single-pen recording transmitter
ElectroniK single-pen recording transmitter

Transmitter features:

- Mechanical or electrical measurements
- Indication and/or recording
- Electric or pneumatic control
- Integration
- Auxiliary contacts
- Remote set controller index receiver
- No load on primary measuring element by either transmitting mechanism or auxiliary contacts

Your choice of transmitter channels

Private wires
Telegraph or telephone circuits
Time multiplexing
Carrier current channels
Tone multiplexing
Radio channels, including microwave, UHF and VHF

Use the new Honeywell *Dur-O-Pulse* telemetering system for fast, accurate, versatile control of natural gas or petroleum pumping stations. It carries process variable measurements up to 100 miles by continuous telephone or telegraph wire pair *without repeaters*, or by microwave, radio or power line carrier systems.

Dur-O-Pulse consists of a transmitter in a standard Honeywell recorder or indicator at the point of measurement, the intervening wiring, a power pack, and a receiver in another Honeywell instrument at the receiving location. Both transmitter and receiver can embody a wide variety of control functions. The system employs the pulse duration technique of telemetering, the simplest, least expensive and most easily maintained of all telemetering systems.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

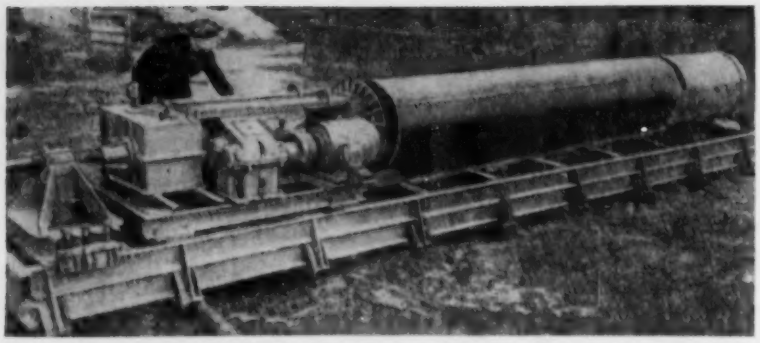
First in Control

Your choice of receivers

Recording receiver
Indicating retransmitting receiver
ElectroniK recording receiver

Receiver features:

- Indication and/or recording
- Electric or pneumatic control
- Integration
- Auxiliary contacts
- Remote set controller index transmitter
- Up to three pens in one circular chart receiver



"Mechanical mole" recently developed by Ukrainian engineers for drilling horizontal holes where pipelines pass beneath railroad embankments and roads.

The Soviet Union expects its pipelines to move around 83 billion ton-kilometers[3] of oil and refined products in 1960 — six times as much as in 1955. The ton-mile increase in 1958 over 1957 was 27 percent, and the gain in 1965 over 1958 is to be "5.6 times."

Whereas the United States had around 163,000 miles of natural gas transmission lines in 1958, the USSR had only 10,000 km (6210 miles). This year's additions will total around 2400 miles.

Under the Seven-Year Plan, the Russian gas transmission network will more than triple. Yet the net annual mileage increase will be far less than in the United States.

Russian cities served by natural gas rose from about 100 in 1956 to 160 at the end of 1958 and will reach 500 by 1965 if goals are achieved. Number of Russians (including all members of the families served) having gas in their houses and apartments is to reach 45,000,000 in 1965 — almost four times the present total.

Industry Served First

As is typical of the Soviet economy, however, industrial needs will be satisfied first. More than 80 percent of the gas produced during the Seven-Year Plan will be used by industry.

Frequently Soviet citizens have to wait many years between the time gas reaches their city and the time they receive service in their apartments. Thus natural gas was first piped to Andizhan, third largest city in Uzbekistan, 15 years ago. But less than 20 percent of the city's living units have gas today because municipal distributing lines have not been laid and because there is a shortage of gas equipment and appliances.

At present, Russia's longest gas transmission lines are Dashava (western Ukraine)-Kiev-Moscow and Stavropol-Moscow, both about 800 miles. Under the Seven-Year Plan there will be several more 800-mile pipeline systems, and two parallel lines from the huge Gazli field in Uzbekistan (said to be the largest in the world) to the Ural industrial centers of Chelyabinsk and Sverdlovsk will each exceed 1200 miles.

The Gazli lines, each with a throughput potential of "up to 10 billion cu m annually," are the most important new natural gas links proposed under the Seven-Year Plan that were not included in the Sixth Five-Year Plan. (Map of Sixth Five-Year Plan gas pipelines was shown in *Pipeline Engineer*, June 1958.)

Moscow, which is now receiving more than 4 billion cu m of natural gas annually from the Carpathian, Saratov, and Stavropol fields, is slated to get more than 13 billion cu m annually by the end of 1965 from these sources plus additions via a new line originating in the Kanevskoe (Krasnodar) field.

Trans-Siberian Biggest Project

Biggest Soviet oil pipeline project under the Seven-Year Plan is still the 2300-mile trans-Siberian system from Ufa and the Tuimazy oil fields in the "Second Baku" region west of the Ural Mountains to Omsk, Novosibirsk, and Irkutsk on Lake Baikal.

This 28-in. system later will be extended farther east to Khabarovsk and Russia's Pacific Coast, a total distance of 4000 miles. It will be able to carry twice as much crude as can be handled by the Trans-Siberian Railway at "one-sixth" the cost per ton-mile.

A 435-mile products line from Omsk, site of Russia's first large Siberian refinery, to Novosibirsk, on the Ob River, was activated early this year. The parallel crude pipeline, which will go on to Irkutsk, is scheduled for completion next year. It will feed refineries under construction near Krasnoyarsk and at Angarsk, near Irkutsk.

From Irkutsk, crude and refined products can easily be transported to China, which is the world's largest purchaser of Soviet oil.

"Second Baku" crude and refined products are also beginning to move through recently-activated pipelines to the north and west. Lines from Almetyevsk in Tataria are supplying new refineries at Perm and Gorky.

A second crude oil line will be built to Gorky, and from there extensions will run to Yaroslavl, Ryazan, and Moscow. Construction on the long products line from the New Kuibyshev refinery to Penza and Bryansk in western Russia has been making slow progress since 1956.

Russia expects its new oil pipelines to bring huge savings in transportation costs. It estimates that moving a ton of oil by rail costs 100 to 600 percent more, and by water 50 to 100 percent more, than through pipelines. Furthermore, most Russian rivers used for large-scale oil shipments are closed by ice during the long winter.

Until 1959, Russian crude and refined products pipelines were mostly 8 to 14 in. in diam. New lines are 20 to 28 in., the long Tuimazy-Omsk-Irkutsk line being the latter size. Some future Soviet oil pipelines will be 32 in. in diam, according to Moscow reports.

Expanding Pipe Mill Capacity

The USSR's State Scientific-Technical Committee says Russia will need more than 1,000,000 metric tons of pipe for crude and refined products trunklines during the 1956-1960 period. Most of this pipe will be in the 20 to 32 in. category.

To meet these requirements, Russia has ordered expansion of existing pipe mills and construction of new ones. The Chelyabinsk, Khartsyzsk, and Zhdanov mills have been directed to lead the way toward a "5 to 7-fold" increase in gas pipe output between 1958 and 1965.

Soviet requests to buy large-diameter steel pipe in the United States have been turned down repeatedly by the Commerce Department, but West Germany and other non-Communist nations have shown considerable willingness to fill Russian pipe orders.

The official government newspaper *Izvestia* and other Soviet publications have urged the use of asbestos-cement, reinforced concrete, and plastic pipe for low-pressure gas lines to free more metal for manufacture of high-pressure pipe.

Station Construction Slow

Besides the pipe shortage, delays in building pumping and compressor stations are causing considerable Soviet concern. A glaring example of Russian difficulties in this regard is the first Stavropol-Moscow gas line. Activated in 1956, it was operating at only half capacity late last year be-

cause compressor stations were still under construction.

Until 1957, Russia's gas transmission lines were equipped with only one type of 1000-hp, gas-engine, piston compressor. In 1958, production was begun on the long-awaited gas-driven turbocompressors "with a productivity 25 times greater than the earlier standard compressor." But deliveries of the more-powerful compressors are far behind schedule. According to *Izvestia*, "the Neva Machine Building Plant started producing centrifugal compressors and gas turbines a year late.

"Thus instead of 18 turbines which should have been delivered in 1958, only two have been shipped. The Myshegsky Equipment Factory and the equipment design bureau of the Moscow Economic Council still have not worked out a reliable design for remote-control valves, nor have they organized production of such valves.

"Because of this, activation of compressor stations on the huge Stavropol-Moscow gas line has been seriously threatened. Unfortunately, these examples are not unique."

Russian turbocompressors now in modest production can handle 13 to 15 million cu m of gas daily at a compression ratio of 1.1:1.25. New gas turbines manufactured at the Neva plant are rated at 4000 kw.

Commenting on Russia's gas pipelining problems, G. Goryachenkov, head of the Engineering Board of the USSR's Chief Gas Administration, declared:

"In order to increase the throughput capacity of existing gas lines, as well as those under construction, we must install hundreds of compressor stations along them. The powerful piston and centrifugal compressors will work off gas turbines, but where cheap electricity is near at hand it is better to use powerful electric motors.

"Our industry is already producing 4500-hp gas turbines. More powerful turbines of 10,000 and 12,000 hp are being planned for compressor stations.

"We will manufacture 1500-kw gas turbogenerators for the power requirements of compressor stations far from electric transmission lines.

"As for the compressor station buildings, it is advisable to use other materials besides pre-stressed, reinforced concrete. Aluminum framework and wall panels made of synthetic and asbestos-cement materials are recommended."

At present, Goryachenkov continued, "our gas pipelines are served by an entire army of personnel. But in the future these workers will not be needed, since the control and regulation of gas pipeline operations will be automated. We plan to introduce centralized automatic remote control on all large gas pipeline systems."

The Soviet officials stated that "research on non-metallic materials for pipeline construction is extremely promising." He added that future Soviet gas lines must be more durable.

"In this regard we plan large-scale introduction of longer-lasting materials for coating metal pipes – bitumen, fiberglass and plastics."

Heavier Construction Equipment

Turning to other pipelining problems, Goryachenkov said that intensive effort is being made to solve the problem of ditching during Russia's severe winters. First shipments have been made of rotary ditchers able to dig in ground frozen to a depth of 0.7 meter (2.3 ft), and the special design bureau of the Gas Industry Construction Machinery Trust is working on ditchers capable of operating in ground frozen still more deeply.

Because gas transmission lines to be built during the Seven-Year Plan will be as large as 1020 mm (40 in.) in diam — twice the size of the largest pipe laid before 1956 — Russia has been forced to design and manufacture an entire new series of more-powerful construction equipment. Pipelayers with a lifting capacity of 25 to 40 metric tons have been ordered. New rotary ditchers will be able to dig trenches 1.5 meters (4.92 ft) wide and 2.5 meters (8.2 ft) deep.

Crews on the second Stavropol-Moscow line who are working with 820-mm (32-in.) pipe have received the TL-15/30 pipelayer with a 15-ton lifting capacity. They are also using new cleaning and coating machines for 820-mm pipe.

The newspaper *Sovetskaya Rossiya* reports that "every second worker at the second Stavropol-Moscow pipeline construction site runs a machine." Welding mechanization on the project is claimed to be the best in the world.

At the same time the newspaper *Izvestia* warns that too few factories are now engaged in developing and manufacturing ditchers, pipelayers, mechanized cleaning and coating machines, and other heavy equipment. *Pravda* adds that "production of gas turbine and electrically-driven gas line compressors and apparatus for automation and remote control must be organized at more plants."

New Equipment for Boring Crossings

Improved equipment is also being developed for drilling horizontal holes where pipelines pass beneath railroads and roads. Pipe is now pushed through with 120-ton hydraulic jacks or by winches with block and tackle. Removal of dirt from the pipe remains a time-consuming process.

Ukrainian engineers recently built a "mechanical mole" for such horizontal drilling. It consists of a cutting head, worm conveyers, a bogie with an 11.5-kw electric motor, two reducers for turning the worm conveyers, and a pushing mechanism.

The mole is designed to push through 800-mm (31-in.) pipe at a rate of 2 meters (6.56 ft) per hr. Maximum pipe length is 60 m (196.9 ft). Tests are also being made with similar equipment for 400-mm (15.5-in.) and 600-mm (23.4-in.) pipe.

Soviet gas industry officials have recognized the need for improving the working conditions of pipeline crews. This will be especially necessary on such projects as the two 40-in. pipelines to be laid across the Kyzyl-Kum Desert from the Gazli field near Bukhara in Uzbekistan to Chelyabinsk and Sverdlovsk.

Daytime temperatures in the Kyzyl-Kum Desert got so high during construction of the Jarkak-Bukhara line that the coating melted, forcing the work to be done at night.

On the Gazli projects, crews may enjoy the comfort of air conditioned trailers proposed as part of "mobile villages complete with dining rooms, infirmaries, stores and clubhouses."

Coordination Lacking

Russia's problems in building crude and refined products pipelines reflect some of the same difficulties encountered in gas line construction. Failure to coordinate the various aspects of major projects is widely criticized in the Soviet press.

Thus a new oil pipeline may stand idle or operate far below capacity for many months because pumping stations are not completed on schedule. The magazine *Neftyanoe Khozialstvo (Oil Economy)* has called attention to the tremendous waste involved in such situations:

"A new 20-in. oil line 800 km (497 miles) long with one head pumping station may cost 300,000,000 rubles ($75,000,000 at the official rate of exchange but closer to $30,000,000 at actual ruble value) and permit an annual throughput of 2,200,000 metric tons. But an additional outlay of only 105,000,000 rubles for seven intermediate pumping stations will provide 5,300,000 tons more throughput annually, bringing the line up to its full 7,500,000 tons per year capacity.

"These figures testify to the inadmissibility of delays in building intermediate pumping stations."

In many cases, *Neftyanoe Khoziaistvo* explained, failure to deliver equipment is the main obstacle to acti-

Now...partners in

Blue Flag Fiber Glass

give you

Blue Flag Wrap (left), has uniform porosity for quick bleed-through of enamel. **J-M Asbestos Felt (right),** saturated with coal tar or asphalt, provides a tough outer shell...3 types for field or mill wrapping.

Buyers of pipeline wraps and tapes are now served by an enlarged staff of Johns-Manville sales and technical personnel operating out of 56 sales offices . . . by expanded distribution facilities . . . by the addition of 7 strategically located plants . . . and by expanded research and product development laboratories. For further information, write Johns-Manville, Box 158, New York 16, N.Y. In Canada, Port Credit, Ontario.

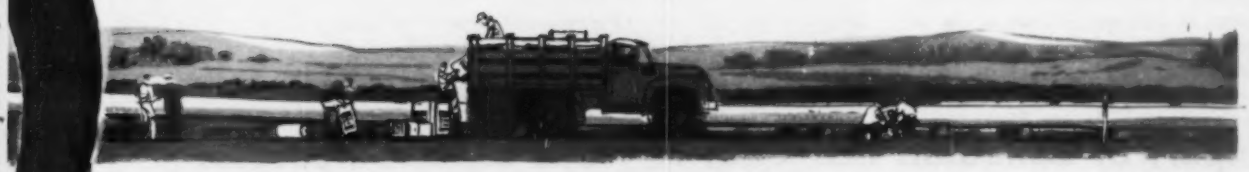
pipeline protection

and Johns-Manville Asbestos Felt join to one responsibility for a better job

...1 For enamel reinforcement

J-M Blue Flag® Wrap—specially formulated from borosilicate type fiber glass—strengthens pipeline enamels the way steel rods reinforce concrete. It reduces cracking and deformation of the enamel. The inorganic fiber glass can't rot, decay or absorb moisture in the ground . . . will add years of protective life to pipeline enamels.

The uniform porosity of Blue Flag allows the enamel to bleed through quickly. It minimizes holidays and helps form an evenly distributed coating with high resistance to soil stresses.



...2 For a tough outer shell

J-M Asbestos Felts, made of fibrous stone, provide a tough, durable outer shell. During the manufacture—natural asbestos mineral fibers are felted, then impregnated with coal tar or asphalt saturant to provide, literally, "a flexible covering of stone."

This outer shell of asbestos protects the enamel against soil stress, earth movement and rock pressures. It resists damage from handling, backfilling, other hazards of installation.

Inert, inorganic asbestos fiber has been uniquely inured by nature over millions of years against rot or decay. Asbestos comes from the ground, is always at home in the ground.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

vation of intermediate pumping stations. "Yet it goes without saying that strict observance of delivery schedules for electrical equipment and pumps for pumping stations is one of the basic conditions for successful fulfillment of the Seven-Year Plan for building oil trunk pipelines."

Neftyanoe Khoziaistvo suggested that since pumping station construction is "incomparably more complex" than laying pipe, work on the pumping station should start well ahead of pipelaying. "In this way the line can go into operation at capacity on time."

100 Stations Planned

Russia expects to build more than 100 pumping stations on oil trunk pipelines during the 1956-1960 period. This would represent a 100 percent increase in pumping stations over 1955 and a "four-fold" increase in their total capacity.

Average capacity of new Russian oil pipelines in 1957 was 20,000 metric tons daily. On new oil pipelines, average pumping capacity is to be 50 to 60,000 tons daily.

Russia first used piston pumps with a capacity of 160 cu m per hr (707 gal per min) on its crude and products pipelines. Until recently, centrifugal pumps of 500 and 750 cu m per hr (3041 to 3312 gal per min) capacity were the largest in service.

Motor-driven centrifugal pumps with a capacity of 1100 cu m per hr (4858 gal per min) are now being built for Russian crude trunk lines of 20-in. diam. Two such pumps connected in series with a third pump in reserve are considered adequate for operating a 20-in. pipeline at "full throughput" of 7,500,000 metric tons annually."

For their 28-in. crude lines the Russians plan to use motor-driven centrifugal pumps with a capacity of 2200 to 2500 cu m per hr (9717 to 11,041 gal per min). Looking to the future, they have called for production of pumps with a capacity of 3500 cu m per hr (15,458 gal per min) for 32-in. crude lines.

It is estimated that the 2300-mile, 28-in. trans-Siberian crude pipeline, when in full operation, will have about 150 pumps of 2200-2500 cu m per hr capacity. Each pumping station would have three such pumps connected in series, with one pump in reserve.

Neftyanoe Khoziaistvo emphasized that electric drive is necessary for pumps used on large-diameter oil pipelines if the desired automation of pumping stations is to be achieved. In the Urals area and Siberia, electrification of Soviet railroads will bring electricity along the route of important new crude and products lines.

"At present," *Neftyanoe Khoziaistvo* complained, "the tempo of introducing automation, remote control and supervisory control, on oil pipelines leaves much to be desired. Until very recently, plans for new oil pipelines contained no detailed provisions for full automation of pumping processes. This was mainly because scientific research and design work has lagged behind the demands of the project organizations."

Through mechanization and automation, Russia seeks to eliminate 8 to 10 workers at each pumping station. Stations on the Penza-Bryansk and Almetyevsk-Gorky oil pipelines will be the first automated under a plan developed by the State Institute for Oil Transportation.

The plan is expected to cut pumping costs from the present 1.8-2 kopeks per ton-kilometer to 0.86 kopeks (100 kopeks equal 1 ruble).

Russia also hopes to improve its oil pipeline operations by greater use of aerial patrolling, vapor-saving roofs on storage tanks, and batching different refined products or oils through a single line. Substantial savings have already been achieved by reducing the wall thickness of line pipe for oil pipelines from an average of 10 to 11 mm (0.390 to 0.429 in.) in 1952 to 8 to 9 mm (0.312 to 0.351 in.) today. ★ ★ ★

Export of Canadian Gas Vital to Trans-Canada's Success

Export of Canadian natural gas to the United States at Emerson, Manitoba, by Trans-Canada Pipe Lines, Ltd., is vitally important to the success of the company's overall operations, James W. Kerr, president of Trans-Canada, said recently in addressing shareholders at the company's annual meeting in Calgary.

Trans-Canada has a contract with Midwestern Gas Transmission Company to sell Midwestern 204,000,000 cu ft of gas daily at Emerson.

Kerr declared that it will always be Trans-Canada's policy to have an adequate supply of gas for use by Canadians. "We have a very abundant supply for Canadian use . . . enough to take care of all foreseeable requirements of residential, commercial and industrial customers in Canada." Some additional gas is now required to fill American contracts and the company is very aggressively negotiating with producers for the additional volumes required.

"It is vitally important that we aggressively expedite our program to export gas to the United States. Fulfillment of the contract between Trans-Canada and Midwestern would be very beneficial, particularly during the company's early years of growth. It is a large volume sale on a high load factor basis to a rapidly expanding American market.

"The export project would result in much healthier earnings for Trans-Canada, and particularly would hasten the time when earnings would permit acquisition of the section of the pipeline owned by Northern Ontario Pipe Line Crown Corporation."

In addition, Kerr observed, proposed export at Niagara Falls, providing for interruptable sales up to 200,000,000 cu ft daily, only after Canadian market requirements had been completely satisfied, would result in high load factor operations for all of Trans-Canada's main line facilities and would provide maximum annual sales of gas.

"We are inherently an important factor in the nation's economy," Kerr continued. "It is not generally known that of our 35,574 shareholders, 84 percent or 29,998 are Canadians. It is also significant that Canadian shareholders own more than 70 percent of our outstanding shares. This maintenance of faith in the future of Trans-Canada by so many Canadian people indicates they appreciate the fact that the company is a great and growing Canadian enterprise."

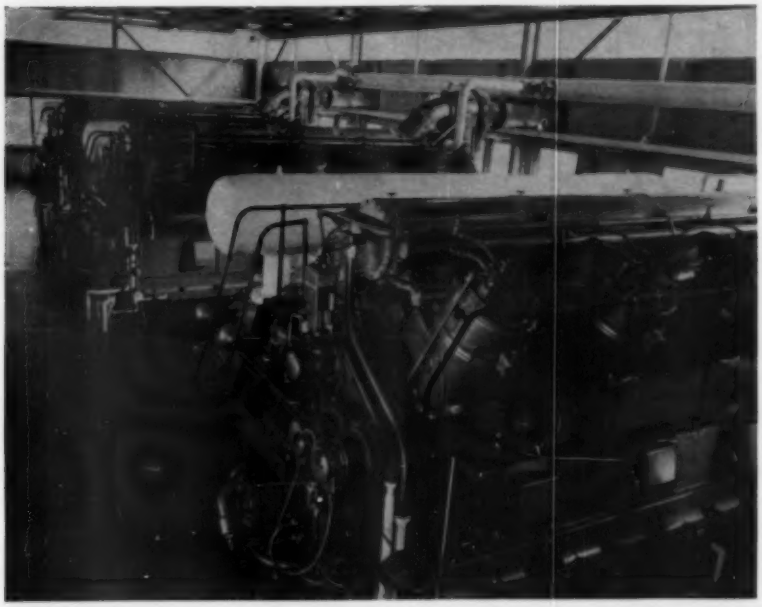
Kerr declared that Trans-Canada also welcomed and would continue to welcome the participation of its 5303 American shareholders. This continues the international cooperation of Canadian and U. S. capital which assured the building of the initial pipeline project and "we hope through the years American citizens will find it profitable to continue their partnership with us." The balance of 272 share owners is in many other countries around the world.

Kerr noted that just six months ago Trans-Canada made the transition from a construction project to a fully operating pipeline system. Completion of the initial 2290-mile project ahead of schedule and below the estimated costs, despite the hundreds of miles of hard rock, muskeg, and adverse weather, had made the project one of the outstanding engineering and construction accomplishments in the natural gas pipeline industry.

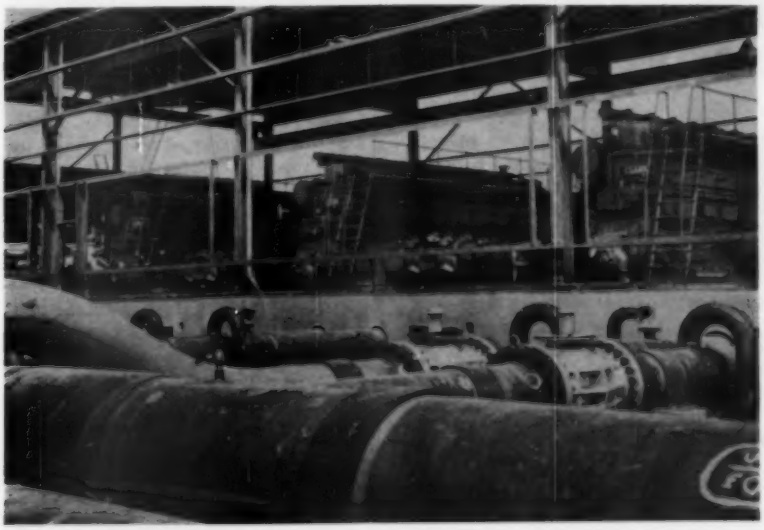
Trans-Canada Has Its Operating Problems

Designed into stations are facilities for operating in cold northern country

Leslie Orr Rowland



Interior of North Bay station, which has a total of 5500 hp — three 10-cylinder, 1800-hp units.



This construction progress photo shows three 3400-hp compressor units mounted in Caron, Saskatchewan, station.

THE FIRST SIX compressor stations on the main line of Trans-Canada Pipe Line, Ltd's. system will be joined this year by four additional stations, to provide a substantial boost in line capacity. Three of the new stations will be built by the Northern Ontario Pipe Line Crown Corporation, with design and engineering under supervision of Trans-Canada. These will be near Ignace, Geraldton, and Hearst. The fourth station will be built by Trans-Canada near Maple, 20 miles north of Toronto.

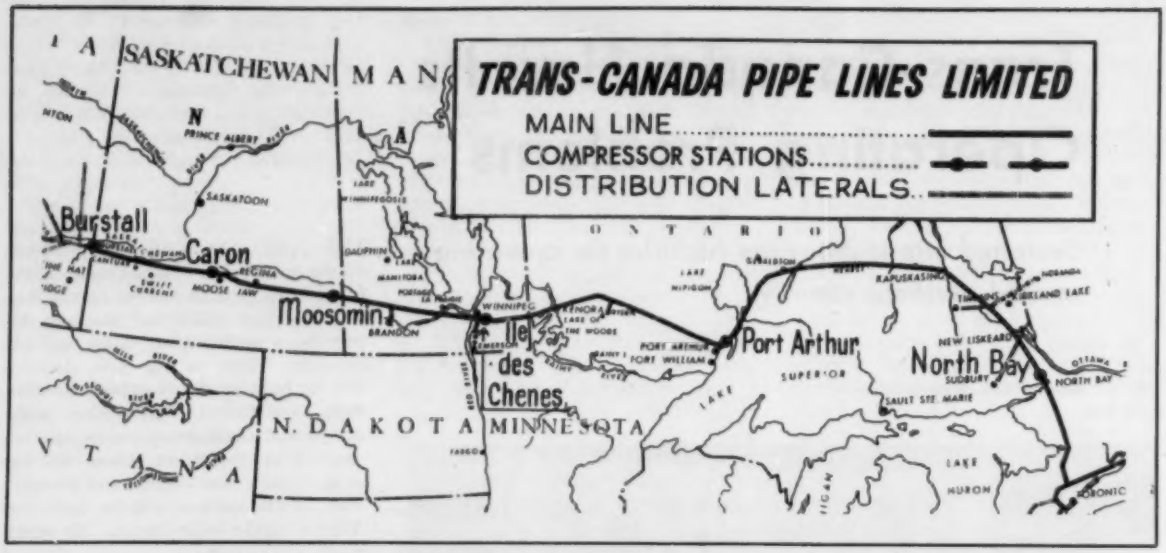
Trans-Canada has been operating with six stations at a capacity varying between 190,000,000 cu ft and 240,000,000 cu ft a day. Rated capacity is 30,000,000 cu ft a day, but Trans-Canada already has asked The Alberta Gas Trunk Line Company, Ltd., to build extensions to its gathering system to provide 446,000,000 cu ft per day for the 1959-60 heating season, indicating that it expects next season's load to be about 70 percent above this season's maximum.

Five of the operating stations are on Trans-Canada's own line and the sixth on that of Northern Ontario Pipe Line Crown Corporation, the latter built as a public enterprise but leased back to Trans-Canada for operation.

Designed for Expansion

The three most westerly stations, all in Saskatchewan, each contain 10,200 hp in three large 10-cylinder, 3400-hp units. The first station, at Burstall, is at the start of the line. The second, at Caron, near Moose Jaw, is about 190 miles east, and the third, at Moosomin, another 185 miles east. The fourth, at Ile des Chenes, is 210 miles east. It contains 7500 hp in three 10-cylinder 2500-hp units. The North Bay station, 230 miles north of Toronto on the southern end of the system, contains 5500 hp in three 10-cylinder nominally-rated 1800-hp units. The Crown station is equipped with 5000 hp, the smallest capacity of the six.

INTERNATIONAL
PIPELINING



Route of Trans-Canada Pipe Line system showing location of the six compressor stations now in operation.

System capacity at present is thus 48,600 hp.

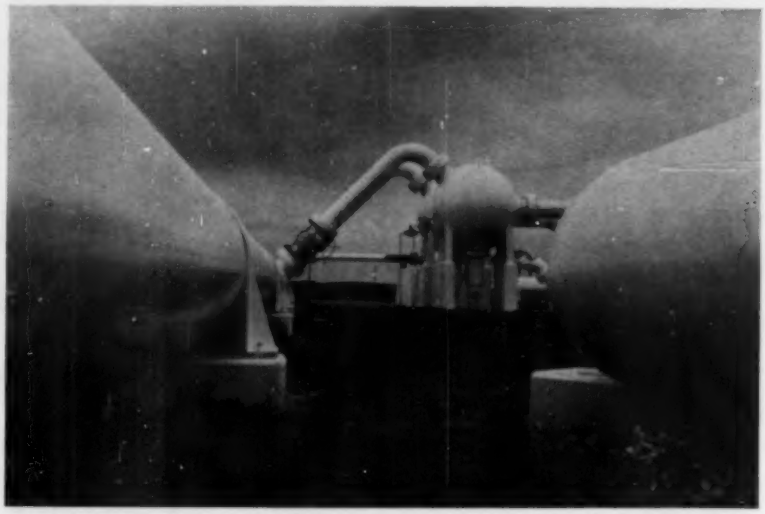
Maximum development at any one station site, on the existing line, will be the addition of one more unit, making a total of 13,600 hp at each of the three largest stations. Provision was made at each station for this installation by pouring an extra concrete base during construction. Besides, station sites have been designed with a complete loop of the original line in mind, and the same station installation will be duplicated on the loop line as required. Facilities can be multiplied in this way almost without limit as expansion becomes necessary.

The system was designed originally with 27 compressor stations as the ultimate. This program is now under review because of the various changes that have taken place already in delivery points and estimated volumes at these points. The general layout of compressor units is also being reviewed, in order to make sure that maximum efficiency will be attained.

The initial stations contain reciprocating type engines, but the engineering staff calculates that it would be feasible to convert to centrifugals to advantage at any point where the station load reaches 400,000,000 cu ft a day or more. With their higher capacity, the centrifugals also operate on a lower ratio of 1.1 to 1.3.

Maximum capacity of the present system, with a single line in operation, is estimated to be in the range of 800,000,000 to 1,200,000,000 cu ft per day before any general looping program will be required, apart from small intermediate loops in a few locations.

The western section is practically all through traffic, with the first steady take-off point at Brandon, in western Manitoba. Deliveries become progressively heavier as the line passes the Lakehead cities of Fort William and Port Arthur, as substantial load is being built up for the pulp and paper mills in northern Ontario. The heaviest and most concentrated deliveries will be in the Toronto area, with moderately heavy loads between Toronto and Montreal, the eastern terminus of the line.



Before reaching the compressors, gas passes through oilbath scrubbers to eliminate moisture and other impurities.

What of Operating Problems?

The system is one of the most northerly and one of the most exposed to severe ground weather conditions to be found anywhere outside of Russia. Hydrate formation is a problem during the long Canadian winter, and efficiency of compressor stations is lowered on the western section. As one precaution, ethylene glycol antifreeze with a cold rating of minus 50 F is being used in all cooling systems. Drips also are installed on the discharge sides of all stations throughout the line.

One of the basic operational problems is water supply on the prairies and at North Bay, and this is considered quite a critical engineering problem. At Burstall, in an extremely dry area, it was found necessary to run a water pipeline from the Great Sand Hills, eight miles north of the station, to tap four shallow wells that found water beds in a sand stratum from 10 to 20 ft below the surface after consid-

Cleveland 190 backfills at steady 2-miles-per-day

One-man-operated Cleveland 190 backfillers, with their exclusive water-cooled throw-out clutches, each averaged a steady 2 miles of backfill per day on Harbert Construction Corp.'s spreads for Houston Texas Gas & Oil in Florida.

The 190's water-cooled throw-out clutch permits continuous, day-long, high-production backfilling. It prevents overheating and maintains proper clutch adjustment at all times for easy accurate casting of the 190's big 7-foot backfill board. It adds hundreds of hours of work life to clutch lining and all clutch components. Location of the 190's boom hinges above the track also permits smoother, farther and more accurate casting and better control of the backfill operation.

The 190's ability to travel at equal speeds in either direction was another valuable advantage on this job, since constant doubling back was required for pipe anchor installations made necessary by the swampy ground conditions.

Get Bulletin L-103 on the Cleveland 190 from your distributor or write:

Good Everywhere®

The CLEVELAND TRENCHER Co.

20100 St. Clair Avenue • Cleveland 17, Ohio

erable exploratory drilling. The usable wells tap stray sand waters, and they have to be selected with care to avoid a heavily alkaline flow, which could damage equipment but is a common occurrence in the prairie terrain.

The Caron water supply comes from an abandoned reservoir that originally was used for part of the Moose Jaw storage. A short water pipeline here taps two shallow wells that were drilled to accumulate runoff filtering into the artificial settling basin, which was part of the reservoir.

At Moosomin a completely impermeable clay soil of high homogeneity occurs, but a natural spring-fed lake was located at a distance of three miles, from which a 2-in. water pipeline was laid to the station.

The Ile des Chenes site has a high water table and no problem was encountered there. At North Bay, although the site was located on swampy muskeg terrain, no usable ground water could be found under the site or within a wide radius, so two water wells had to be drilled at a distance of two miles and a small-diameter water pipe laid to connect them with the station.

The wall construction, uniform for all stations, is expected to prove useful in combatting weather, both cold and wind. On the prairies, particularly, wind is a severe factor. A combination of very light weight with high resistance to all types of weather has been accomplished with a sandwich panel, which is laminated from a single 1½-in. polystyrene panel with a ⅛-in. flat asbestos panel on each side. The weight is a mere 2.12 lb per sq ft, but the panel has a high insulation and rigidity rating when hung on the steel frame that is standard construction for all buildings. It also has the advantage of requiring no exterior painting or other protective treatment, and in a few months since installation has weathered to the appearance of stainless steel or aluminum siding.

An unusual extra piece of equipment at each of the Saskatchewan stations was made necessary by the electric power limitations of the Saskatchewan Power Corporation. A self-contained power supply has had to be provided by the use of two 250-kw, 312.5 kva (at 720 rpm) 60-cycle, 3-phase gas-engine generating units that operate on line feed. * * *

Abstracts of World Petroleum Congress Pipeline Papers

Section VIII — Paper 9

Techniques Employed In The Study and Development of Underground Storage of Gas in Aquifer Sands

E. Clarac, Societe Nationale des Petroles d'Aquitaine
R. Monicard, Institut Fracais du Petrole
L. Richard, Gaz de France

Storing gas in unconsolidated aquifer sands is now in operation in France — a much more complex venture than storing it in old depleted stratas, which are non-existent in France. Different methods based on transient flow in porous media were widely used for the development of such underground storage. Ascertaining the properties of the aquifer, determining the skin effect, and locating faults and the extension of the reservoir in the vicinity of a well are covered in this study.

Section VIII — Paper 12

Microwave Communication In Pipeline Operation

Fred S. Jones
Superintendent of Engineering and Communications
Platte Pipe Line Company

A study of the evolvement of pipeline communications from single circuit telegraphy and telephony, to extensive wireline systems interconnecting pumping stations and offices, to multichannel microwave radio relay equipment, which have and will continue to bring about new techniques of pipeline operation such as unattended remotely-controlled booster stations, unattended injection and delivery stations, and automatic data logging.

Section VIII — Paper 14

Scheduling And Control Of Multiple Pipeline Tenders By Electronic Computer

W. G. Horstman, Vice President, Operations
G. W. Chism, Chief Dispatcher
W. R. McDonald, Section Head, Data-Processing Operations
Plantation Pipe Line Company

This paper presents the basis for Plantation's decision that an electronic data-processing system could be used advantageously on its complex, multitube system — and describes the application of a digital computer, together with the necessary auxiliary communications and printing equipment, for the control of refined products movement through the pipeline.

Section VIII — Paper 15

Construction, Operation And Maintenance Of Offshore Pipelines

S. V. Collins, President
Collins Construction Company

A discussion of marine construction, its natural hazards, the proved techniques of installation in use today, the new problems of stress control and handling being created by larger diameter pipelines, a study of the solutions to these problems, and maintenance during the preparation and installation phases of construction.

Section VIII — Paper 16

Electrical Heating Of Pipelines Carrying Viscous Products

C. F. Mares, Engineer in Charge - Utilities, Refineries and Technical Dept., British Petroleum Company, Ltd.

The system described employs mineral insulated metal sheathed cables as heating elements, normally applied externally to the pipe beneath the lagging; but internal application, particularly suitable for buried lines carrying heavy fuel oil, also is described. The composition and characteristics of heating cable used, selection of suitable metals for core and sheath materials to suit operating temperatures, and a brief reference to economics are given.

Section VIII — Paper 17

Synthetic Pipeline Coatings

M. J. Dabney, O. C. Slotterbeck, D. F. Koenecke, Esso Research Engineering Company

With the economic incentive for taking a new look at better external coatings for underground lines, this study presents data on several of the better thin coatings from about 60 different resin types and formulations that have been laboratory screened in the N/2 sodium chloride electrolytic cell test under a 6-v impressed d-c current. Results are given, as well as a new technique of directly impinging an open flame on a formulated butoxy coating.

Section VIII — Paper 18

Custody Transfer By Displacement Meters

L. S. Wrightsman, Coordinator of Gaging Operations
Humble Pipe Line Company

This discussion includes definitions of the terms "custody transfer" and "positive displacement meter," using positive displacement meters in measuring runs from a producer's lease tank into a pipeline gathering system, use of positive displacement meters in crude oil pipeline operations and custody transfer measurements between different pipelines, uses of custody transfer crude oil deliveries from pipelines to refineries, and new practices in the application of automation to meter proving procedures.

Motorola "MOTRAC" Radio means...

Reliability

...*longer life*—No tubes in the receiver, no vibrators in the power supply...all replaced by pre-aged, double-checked transistors. Power transistors have a 67 to 150% power safety factor.

...*cooler operation*—Up to 40° (F) less than other sets.

...*lower power consumption*—80% less current drain on "standby" —10 to 15% less during "transmit."

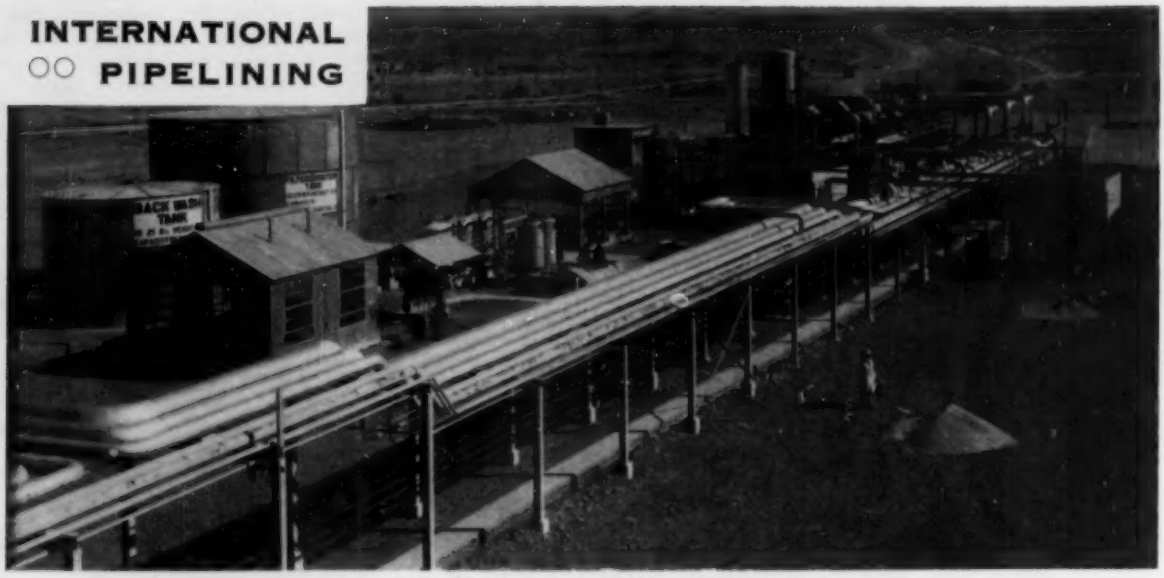
...*greater audio output*—5 watts (2½ to 3 times that of conventional radios).

"MOTRAC" radio is the most far-reaching advance in 2-way radio since the introduction of FM. The result of a six year, three million dollar development program. Available now. Call or write today.

MOTOROLA "MOTRAC" 2-WAY RADIO
MOTOROLA COMMUNICATIONS and ELECTRONICS, INC.
4501 AUGUSTA BOULEVARD • CHICAGO 51, ILL.

MOTRAC is a trademark of Motorola Inc.

INTERNATIONAL
○○ PIPELINING



The start. This plant, first of its kind in Asia, purifies gas at its source in Sui field before it starts on its journey of 347 miles to Karachi and 384 miles to Multan. Plant capacity is 52,000,000 cu ft a day.

Sui-Multan Pipeline Is Asia's Second Long Transmission System

First phase of plan to provide natural gas to industrial consumers in northern Pakistan

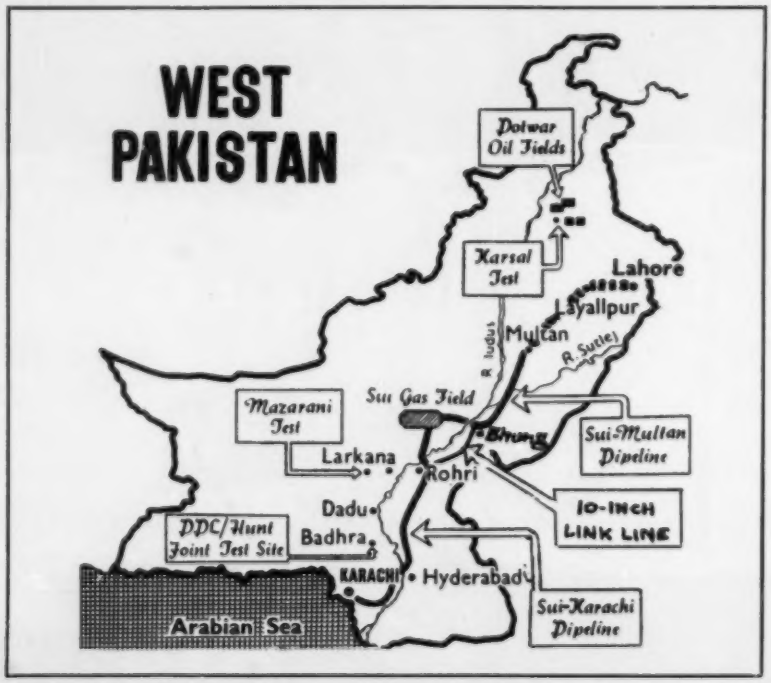
V. S. Swaminathan
London, England

NATURAL GAS is now flowing through the Sui-Multan pipeline of the Indus Gas Company, subsidiary of the Pakistan Industrial Development Corporation, giving Asia its second long-distance transmission system. The project was planned, designed, and engineered for PIDC by Sui Gas Transmission Company, Ltd., and turned over to Indus Gas for operating upon completion.

Originating in the Sui gas field and extending to Multan, the pipeline covers a total distance of 384 miles. Construction is of 16-in. pipe except for 83 miles of 10-in. that was laid to connect an offtake point from the Sui-Karachi gas line near Rohri to the main pipeline on the east bank of the Indus River. Almost two years were required to accomplish the project. Clearing the 40-ft right-of-way began in October 1956, and the first joint of pipe was welded on December 18.

Two Mighty Rivers Crossed

Building the 112 miles of pipeline between the Indus and Sutlej rivers was completed in early March 1957. Crossing of these two mighty rivers presented the most formidable problem of



Map shows route of the Sui-Multan pipeline, as well as the Sui-Karachi line, built previously, and the proposed extension to Layallpur and Lahore.

Machines also available on rental basis

"NO SHUTDOWN WHILE CUTTING INTO THE LINE with a WmSon-Hillco Tapping Machine. When the tap is completed, Williamson Stopples plug the line temporarily while the flow continues through a by-pass. You can make repairs, replace piping, connect process units and booster stations, install fittings, extend or abandon piping. It's all done without shutdown and ***WITH COMPLETE SAFETY!*** "

Offering years of research and experience in hot tap operations

T. D. Williamson, Inc.
P. O. BOX 40 TULSA 2, OKLAHOMA

REPRESENTATIVES AROUND THE WORLD

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

all. Special equipment designed for the task, scheduled to arrive in November 1956, was delayed by the closing of the Suez Canal until January 1957. Crossing of the Indus, which floods to a width of seven miles during the rainy season, and sends its waters tumbling down at a speed of about 10 knots, could be accomplished only during the winter months (December to February), and it was the end of 1957 before a start could be made.

A construction camp was established on the south bank of the Sutlej, and special equipment required for the river crossing (including pontoons, dewatering equipment, and dredger) reached the location on time.

Drive point wells were situated at 5-ft intervals and connected to a high capacity pump to lower the ground water level so that excavation work could be done in a comparatively dry river bed. A trench was excavated three miles long and 27 ft below the bed of the Sutlej River.

Erection of repeater stations, built at approximately 35-mile intervals along the line, and designed to house both radio and cathodic protection equipment, progressed according to schedule in the early months of 1957. The river crossing camp at the south bank of the Sutlej River was linked by high frequency radio with the office of the chief engineer of the project in Karachi, thus maintaining a communications link between the camp and headquarters. Four repeater stations having diesel-engine-driven generators were installed for use during construction only and were replaced later by gas-engine-driven generators. To ensure high frequency radio communication three 150-ft steel towers were set up at Multan, Shujabad, and Uch.

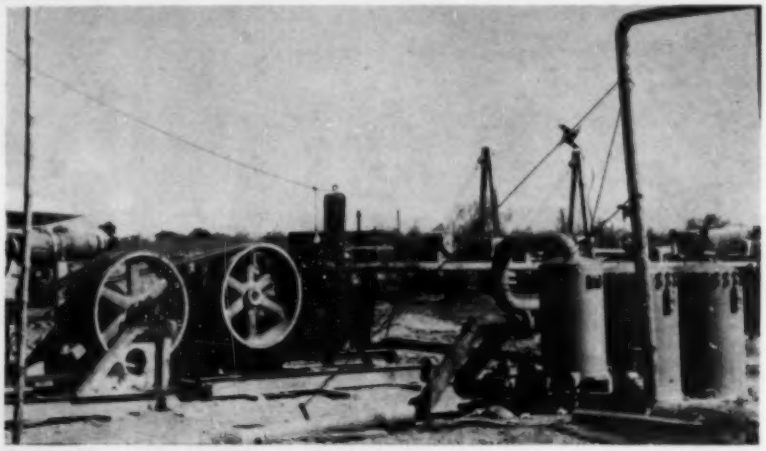
In July 1957, the Sui-Multan pipeline was completed with the exception of the 6-mile Indus River crossing (including approaches). Then came the most difficult part of the work — laying the 7000-ft section across the Sutlej River at a depth of 27 ft below the river bed. This was facilitated by the use of special dewatering equipment, which lowered the underground water level by 15 to 17 ft, thereby creating dry conditions for the excavation and removal of 1,500,000 cu ft of dirt and sand from ground to water level.

Good Welding Speeds

Welding speed was even greater than in the case of the Sui-Karachi pipeline. On April 11, 1957, the front-end welding team joined 405 joints of pipe, thus breaking the previous record of 401 joints made in a single day in 1955 on the Sui-Karachi line.

External diameter and wall thickness of the pipe used in the Sui-Multan line are 16-in. and 5/16 in.

The link line. In view of the uncertainties of the River Indus it was found expedient to abandon the underwater crossing of the Sui-Multan gas line and instead lay an 83-mile, 10¾-in. link line to the west bank of the Indus for making gas available to the 16-in. line to Multan. This photograph shows a portion of this link line, which may be removed when Guddu Barrage gets ready and the 16-in. line is laid across it.



Hydrostatic testing. More than 85,000,000 gal of filtered water were required to hydrostatically test the Multan pipeline. Photograph shows the equipment used for testing purposes. The pump employed was a slush pump powered by a diesel engine and fitted with interchangeable liners in order to increase the hydraulic pressure to the maximum required for the tests.

Notwithstanding technical and supply problems, and bad weather conditions, the work was completed on time. Simultaneously, all supporting aspects of the undertaking, such as construction of industrial and residential buildings, telecommunications, cathodic protection installations, metering systems, and electric controls, were in progress. Forging ahead at a rate of more than a mile a day, the pipeline covered 167 miles by the beginning of May 1957.

Link Line Laid

Late in 1957, PIDC, in view of the uncertainties of the Indus River, complicated by barrage building work, abandoned a proposed underwater crossing of this stream and instead laid a new 83-mile, 10-in. diam link line to the west bank of the river to make gas available to the 16-in. line to Multan. Work on the link line from the offtake point at Rohri to the main Multan line on the east bank of the Indus in the vicinity of Bhung, was begun early in 1958. By the end of March 1958, welding of the 10-in. line was completed.

When the Guddu barrage is completed, this link line will be replaced by the installation of a 16-in. section across the barrage itself. The 83-mile, 10-in. pipe will then be reclaimed and be available for extension of the project north of Multan. PIDC's plans to extend the Sui-Multan gas line to Lyallpur already have been approved by the Government of Pakistan.

A gas purification plant already exists in the Sui gas field, having been completed in 1955, and a second plant is now under construction.

Line to be Extended

Completion of the Sui-Multan pipeline is the first phase of a comprehensive plan to provide natural gas to industrial consumers in the northern areas of Pakistan. The second phase calls for extension of the line to Lyallpur, a waxing industrial center in the rich canal colonies. In the third phase the line will reach Lahore. On completion of these undertakings, which will involve the laying of 200 miles of pipeline, the whole of western Pakistan will have inexpensive energy. ★

Aerial view of the water transport unloading point, offices, and No. 2 location at Oloibiri, the first oil field in Nigeria.

Shell-BP Petroleum Development Company faced a problem in getting crude out of its new field in the jungles of Nigeria until it built a . . .

Pipeline Through Bush and Swamp

Walter Sekules

IN NIGERIA, British colony on the west coast of Africa, a new 10-in. pipeline carries oil from the country's first producing oil wells to the Atlantic Coast at Port Harcourt. For the major part of the 70-mile route access had to be made through virgin bush and large swamp areas. There were eight river and creek crossings and only nine miles of the route is along improved roads.

The pipeline was constructed in two stages by Shell-BP Petroleum Development Company. First, a 7-mile section of 8-in. line was laid from oil wells at Oloibiri to Kugbo Creek, completed in December 1957, which allowed oil to be moved by barge to the terminal at Port Harcourt. The second stage, and main part of the system, consists of 63 miles of 10-in., which extends on to Port Harcourt. The line was constructed of API-5L pipe supplied by American, British, and European manufacturers.

Headquarters camp was situated at Egbema, about midway along the line. Pipe was delivered by barge to dumps situated on rivers or creeks, and was strung by tractors pulling trailers or towing heavy sledges in swamp areas.

Three welding crews were employed, one a utility crew to handle river crossings. Two main spreads started from Egbema, one working toward Port Harcourt, the other toward Kugbo. There was radio contact between the camps at all times and helicopters transported men and materials to camps where no roads were available.

The line was laid mostly above ground, resting on the ground except in wet places where it is raised on wooden and steel supports.

The longest river crossing was about 500 ft. Pipe joints were welded on the bank and pulled into place.

Welding was in accordance with API Specifications. Bends were made with hydraulic bending equipment. Scraper traps were prefabricated at Egbema and shipped to site. Welding machines were 300-amp single-operator diesels.

Pipe that was used in swamps, river crossings, and buried was coated and wrapped. Combinations of a paint-type coating, glass fiber wrap, and a cement-type outer coat were applied. To protect the coating from damage, strips of palm fronds were wired together to form a mat, wrapped around the pipe, and wired in place.

Buried pipe was given a 12-in. cover, except when it passed through villages, then it was buried to a depth of 36 in.

The line was tested in sections to a pressure of 1000 psi.

Welds were tested with gamma radiography. One radiographer and one assistant worked with each spread. On the main line 10 percent of the welds were tested, but for river crossings all welds were tested.

Magnesium anodes were installed to combat corrosion.

In the swamp area of eastern Nigeria, pipe was strung with 8-ton trailers pulled by tractors, for the most part. Where trailers could not operate, tractors on 30-in. pads hauled the pipe from dumps to areas of dry ground close to the right-of-way. Here the pipe was welded into strings consisting of 6 to 8 joints. These were winched into position by tractors and positional welds made to tie them into the line. Through the worst swamps, sand roads had to be constructed in advance of the pipe gangs. * * *

Fifty Years of Progress in Pipeline Operations

Part 2 | **Present trend is to break with traditional evolutionary type of progress and move ahead faster**

Wallace K. Luse
Head, Civil Engineering Group
Interstate Oil Pipe Line Company

Pipeline Patrol

Patrol of early pipelines was done by pipeline "walkers" or "riders." The walker would walk along the right-of-way from one station to the next and back again. The round trip of 70 to 80 miles usually took a week. The riders rode horses. Walkers and riders would get their meals and spend the night at farm houses or towns along the route. In some remote areas, cabins were constructed by the company so the patrol would have a place to spend the night.

The patrol's primary duty was to detect leaks in the line and, if possible, repair them. This usually consisted of caulking a leaky "collar," or installing a clamp over a pit hole. The patrol carried a hammer and caulking tools with him and, in anticipation of need, kept some digging tools, wrenches, and clamps stored at points along the pipeline. This was often at some farm house by agreement with the owner who was usually happy with the arrangement, as it gave him an opportunity to "hire out" for a day now and then to help the patrol make repairs.

Other duties of the patrol were to inspect river and creek crossings for caving of banks or undercutting of the line, to report construction or other operations that might endanger the line and look for signs that might indicate tampering with the line. He also watched for erosion or settling of the ditch backfill that might cause damage to adjacent property or injury to farm animals. He was, in many instances, the company's public relations man or traveling ambassador and sometimes even settled damage claims.

In 1945, the patrol of pipelines by airplane was started. This has become an almost universal practice with pipeline companies either by contract or company owned aircraft.

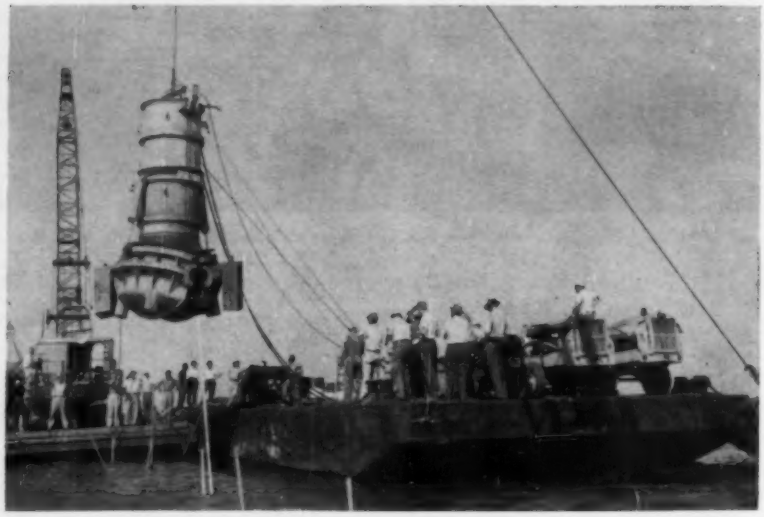


FIG. 8. Caisson for underwater pipeline repairs . . . a recent innovation.

The use of airplanes has largely eliminated the need for pipeline walkers. The air patrols do a more complete and faster job and are quickly available for special patrols in case of emergency.

Maintenance

Heavy station maintenance, particularly of the engines and pumps, was done by traveling crews that came to the station and stayed until the job was complete, then moved on to the next station. Any maintenance necessary before the next visit had to be done by the regular station crew. This made it necessary to have people who were mechanics as well as operators.

Today, with automobiles and good roads, a mechanic is seldom more than a couple of hours away so that the station mechanic is no longer required.

When pipeline repairs beyond the line walker's capabilities were required, men, tools, and materials were taken to the job, in most cases, by wagon. The men remained at the site day and night until the job was finished, including cleanup and burning of the spilled oil. In some locations where the pipeline followed a railroad right-of-way, a work train was sometimes obtained from the railroad to transport the men and tools. Wagons and teams needed were rented, and in most cases, the services of the owner, or driver, were included in the rental paid. When automobiles and trucks came into use, they were often rented on the same basis.

Modern equipment and transportation has largely changed the procedures. On land, equipment can usually be moved in quickly, and spilled oil is, in many cases, pumped back into the line with portable equipment. In many instances, the patrol airplanes are called out to locate the site of an emergency. Radio communication between the pilot and company headquarters, stations, cars, or trucks makes it possible to direct repair crews to the site with a minimum of delay. The result is reduced shutdown time for the pipeline, reduced oil loss, and reduced property damage.

Water operations present many problems not encountered in overland pipelining, and as a result, new equipment,

HOT WEATHER FASHION SHOW

The Coolest Pipe Lines This Season Will Wear—

REFLECTO

(WHITE)

Nicolet REFLECTO (White) reduces enamel temperature as much as 30°F. This added protection will keep the enamel at a uniform thickness all around the pipe.

Independent research laboratory tests prove that, under controlled surface heat of 140°F. enamel beneath black felt registered 156°F. Enamel beneath REFLECTO (White) registered 126°F. — a **temperature reduction of 30°F.**

In addition, use on many domestic and foreign jobs has proven the worth and versatility of REFLECTO (White) in a great number of applications. Stocking problems have been solved and considerable transportation savings effected.

Nicolet REFLECTO (White) weighs 10 lbs. per 100 sq. ft., is reinforced with ¼" spaced parallel glass strands, has Neoprene built right into the sheet — not impregnated or coated — and has a high resistance to scuffing and atmosphere moisture.

Put REFLECTO (White) to work for you now — it's not too late to specify REFLECTO on this Summer's lines. Write, wire or phone today.

NICOLET INDUSTRIES, INC.
Florham Park, N. J.

Norristown, Pa. Hamilton, Ohio

DISTRIBUTED THROUGHOUT UNITED STATES.

techniques and procedures had to be developed. The "caisson," described in the December 1958, issue of Pipeline Engineer, is such a development. (See Fig. 8) The caisson makes it possible to make connections to, or repair pipelines underwater without raising the line. Heavy water equipment, such as floating cranes, work barges, and dredges are rented or obtained under contract.

Trunk Line Stations

Early pipeline stations were steam powered, utilizing converted water works equipment. Pipeline crude or coal was burned in the boilers. By the time Interstate's predecessors entered the pipeline business, oil burning engines were coming into use in pumping stations. Some of the stations built in 1909 and 1910 used oil engines and some steam, but both used pipeline crude as fuel.

These stations, like those built by other companies throughout the country, were generally in remote areas not served by electric power lines or gas lines. The stations were, of necessity, self sufficient with electric power generating equipment and a water and sewage system. The electric power was 110 volts direct current and used for lighting only. Carbon-arc lamps were used initially in the engine room portion of the building; however, these were replaced with incandescent lamps. Electric current was also furnished to the employee cottages. Since the stations often had the only electric power in the area, lamp bulbs could not be purchased locally, so the company furnished them for the cottages.

Most pipeline companies have discontinued the practice of providing housing for employees. In the location where company housing is still available, purchased utilities are generally used.

The practice of generating auxiliary power at pipeline stations has largely been discontinued. If auxiliary power is generated, it is usually alternating current.

Several of the stations built in 1909 and 1910 used triple expansion Corliss type steam pumping engines directly connected to triplex double acting plunger pumps. These units, one of which is shown in Fig. 9, developed about 450 hp. Initially, pipeline crude was burned in the boilers; however, at later dates, some converted to gas fuel.

Other stations built at the same time used 85-hp, single cylinder, horizontal, "hot bulb," air injection, oil engines connected to vertical triplex pumps capable of pumping about 7000 bbl per day. In 1912, 140-hp engines of the same type were installed with horizontal pumps capable of about 10,000 bbl per day. These were later converted to solid injection and compression ignition with horsepower raised to 100 and 150, respectively, and fuel consumption reduced. (See Fig. 10.) By 1920, engines of 300, 400, and 500 hp were common. In 1922, Interstate had five stations with 13 crude burning diesel type engines and reciprocating pumps in each station and one station with 12 such units on one trunk line system. The interior of one of these stations is shown in Fig. 11. These stations required as many as 20 men each to operate. Stations were spaced about 40 miles apart, and the lines between consisted of four to six 8-in. lines on the high-pressure end and two 12-in. lines on the low-pressure end.

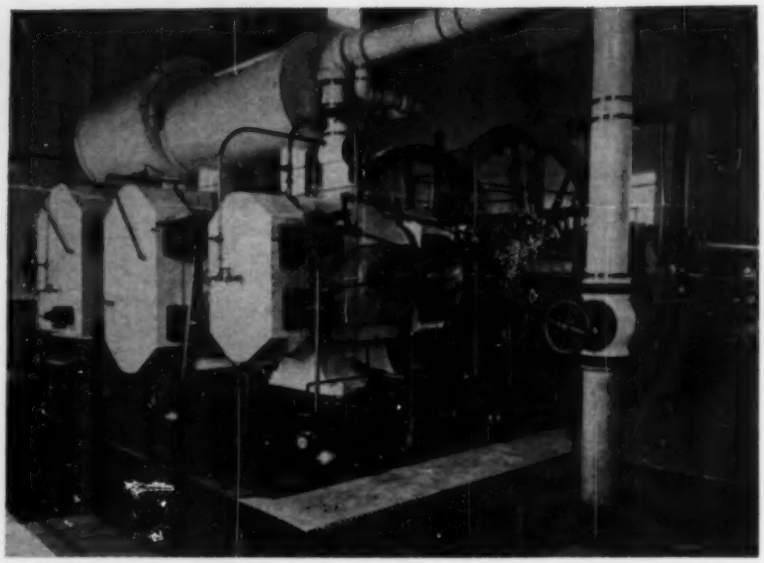


FIG. 9. Triplex steam pumping engine.

In 1952 and 1953, most of this system was replaced with a single 20-in. or 22-in. line and two pumping stations. One of the stations utilizes dual fuel engines and the other electric motors, both driving centrifugal pumps. The entire system now requires about as many men as one of the former stations. The pumping units of the electric station are shown in Fig. 12.

A major break with tradition was made in the early 1920's when gas engines were installed instead of crude burning engines. Today, the use of gas engines on oil pipelines is common practice.

During the late 1920's, extensive use of electric driven pumping units began. Interstate's predecessors installed motors up to 700 hp on reciprocating pumps in 1927 and up to 1000 hp on

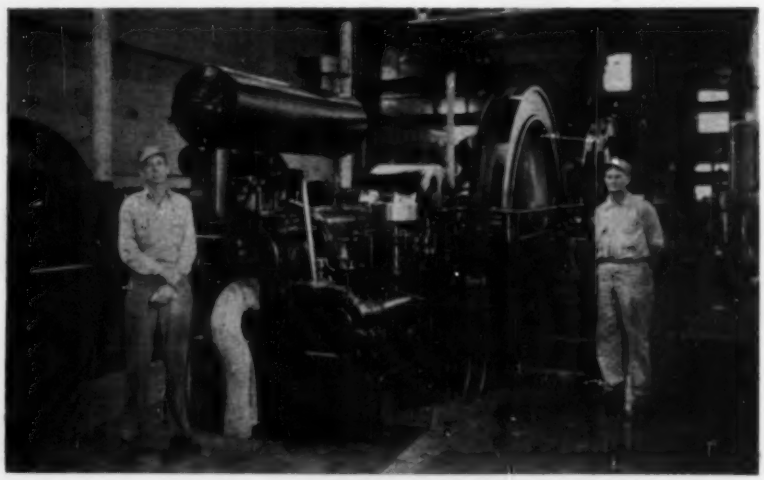


FIG. 10. Converted 100-hp oil engine, installed about 1910.

POWER BOOSTING RICHFIELD'S 2-CYCLE GAS COMPRESSORS

Richfield Oil Corporation's compressor installation at Coles Levee, California, is one of several which have accumulated thousands of hours of trouble free operation with the Multiple AiResearch Turbocharger System.

...*The Multiple* **AIRESEARCH** *Turbocharger System*

has helped solve the Richfield Oil Corporation's need for more power to meet increased demands at its compressor stations. Turbocharging the 2-cycle natural gas engines with the Multiple AiResearch Turbocharger System proved to be an economical and quick method for boosting power.

The turbocharger installation is simple and clean. Two production-type AiResearch turbochargers are mounted directly on the exhaust manifold. The compressed air is directed to the engine intake through an AiResearch intercooler. This increases engine output from 300 H.P. to 375 H.P.

AiResearch is a leader in the development and production of air-cooled turbochargers and turbocharger controls for all major diesel engine applications.

Your inquiries are invited.

THE GARRETT CORPORATION

AiResearch Industrial Division

9225 South Aviation Blvd., Los Angeles 45, California

DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS

centrifugal pumps in 1928. These were, of course, fully manned stations, but it was the beginning of a trend that has led to manned "pushbutton," semi-automatic, remote controlled, and fully automatic stations.

The first automatic station built by Interstate was rather simple 3-unit, 450-hp station operated by a float switch in a 20,000-bbl storage tank. Now under construction is a 120,000-bbl per day, 4-unit, 3600-hp station that will be equipped with automatic schedule or pumping rate controls and automatic batching controls. The station will not require operational attendance, nor will it be remote controlled, other than for emergency shutdown. The rate controls will select the combination of pumping units required, depending on the total amount of crude on hand in the three 55,000-bbl storage tanks. Two grades of crude will be automatically batched, and the station will "report" each hour, also automatically. The report will be typed out on a tape for permanent record.

Larger, more efficient engines, using less expensive fuels, have materially reduced the operating cost of internal-combustion engine stations. Similar savings have been realized at electric stations by reductions in manpower and maintenance.

Tankage

When the original stations were built on Interstate's system, tankage consisted of two or three 37,500-bbl storage tanks at certain stations and one 17,500-bbl tank at intermediate stations. These were of riveted shell with wood cone roof construction. Just prior to World War I, 40 55,000-bbl tanks were built at one intermediate station. During 1921 and 1922, 52 55,000-bbl tanks were built at a station adjacent to a "boom" oil field. Earthen storage, or open pits, were not uncommon during the "boom" days.

Welded roofs, floating roofs, and welded tanks came into use in the late 1920's. The first remote reading tank gages were used about this time. The first such gage on record used by Interstate's predecessors consisted of an inclined tube filled with mercury. Air was admitted into a line leading from a diaphragm on the side of the tank to the inclined tube until the "system" was balanced. The length of the mercury column indicated oil height. The incline angle of the tube could be changed to compensate for the gravity of the oil in the tank. By manipulation of valves in small diameter air lines, several tanks could be gaged by one inclined mercury tube. The gage, while crude in form, did, with careful manipulation, give a reasonable indication of tank liquid level at a remote point, usually the station office several hundred feet away, but it was not an automatic gage.

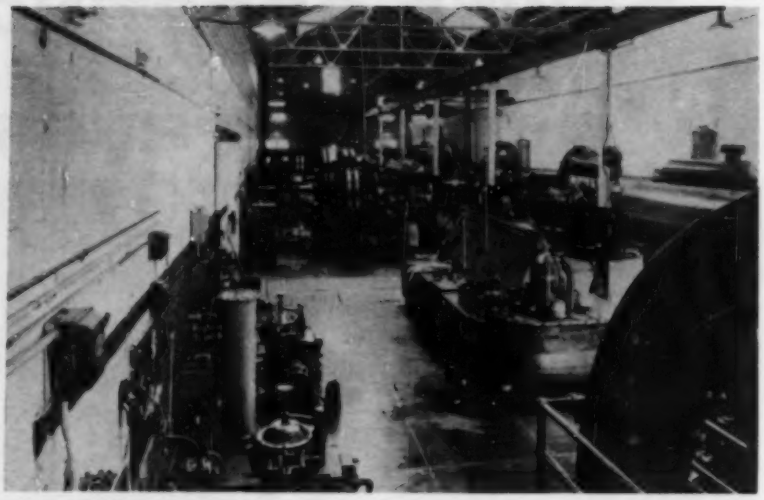


FIG. 11. Engine room of station with 13 oil engines.

Automatic remote reading gages came into general use about 1940 and have been continually improved until reliable readings of tank level are now transmitted for hundreds of miles.

Tank sizes have continued to grow until tanks of 120,000 bbl and above are used extensively. Most tanks built in recent years on crude oil pipelines are equipped with floating roofs. A large number of the new tanks built, as well as some older ones, are equipped with electric "mixers" to reduce "bottoms" or bs&w buildup. The surface of the oil in older cone roof tanks is, in many instances, covered with a floating "blanketing" material to reduce evaporation losses. Pipeline companies have largely gotten out of the storage business. Most modern stations have only enough storage to meet operational requirements.

Communications

In the early days of pipelining, operational communications were by telegraph on lines owned by the company. This undoubtedly was copied from the railroads, and many of the pipeline telegraph operators came from that industry. It was not until about 1920 that

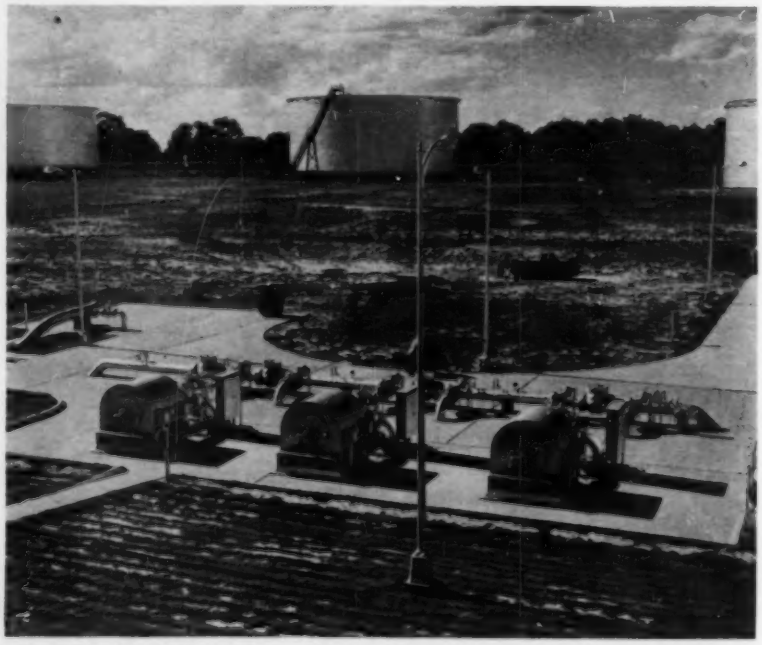
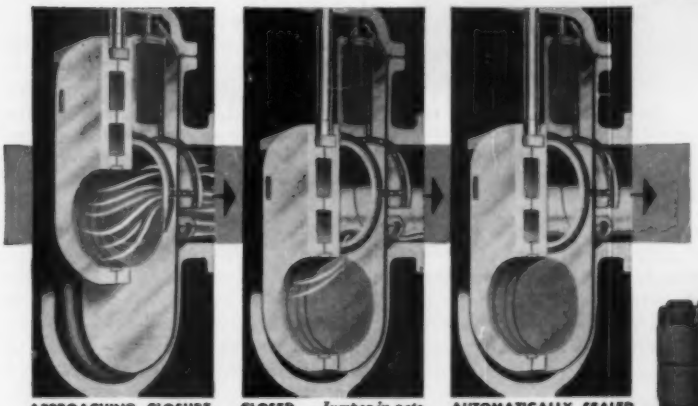


FIG. 12. Electric pipeline station ... three 1500-hp units. This station replaced the one shown in Fig. 11.

For pipeliners who hate leaks!

DARLING-McEVOY SELF-SEALING CONDUIT VALVES



APPROACHING CLOSURE ... *No loss of sealant as sealing groove in seat is disconnected from reservoir until gate is fully closed.*

CLOSED ... *Jumper in gate now permits differential pressure to feed sealant into seat groove to check any remaining flow.*

AUTOMATICALLY SEALED ... *Pressures again in balance. Tightness established. No additional sealant used until again needed.*

THE DIAGRAMS above show how these unique conduit gate valves seal themselves *automatically* . . . by means of a long lasting reservoir-held sealing compound . . . for leak-proof, pressure-tight closure every time! This feature, with flow in either direction, self-aligning non-wedging gates, and fully protected non-distorting seats, means exceptional performance, utility and service life. For additional information on these fully field-proved Darling-McEvoy valves, ask for Bulletin 5402.

DARLING VALVES

DARLING VALVE & MANUFACTURING CO.

Williamsport 2, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Company, Ltd., Galt 19, Ontario

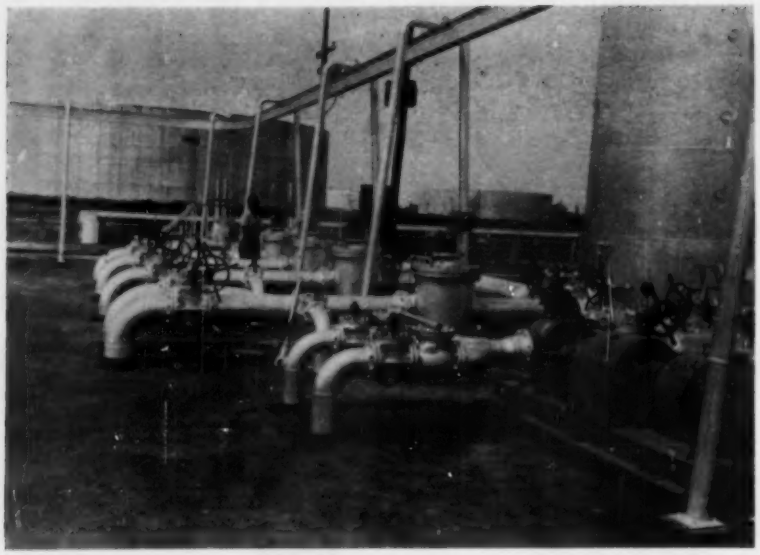


FIG. 13. Portion of meter terminal . . . positive displacement meters, calibration tank, and tank pump-out pump.

voice communication came into use. One of the first attempts was made with an instrument called a "telegraphone" that could be used over the same wires that carried telegraph messages. It was intended for use on distances of about 40 miles and usually worked quite well from one station to the next, but acceptable conversation with the second or third station down the line was the exception rather than the rule. Conventional "physical circuit" telephone soon came into use, and by 1930, "carrier circuit" telephone provided satisfactory communication over the entire system.

Radio communication came into use in remote areas in the late 1940's and grew until virtually all of the system is now radio equipped, including many company owned cars, trucks, boats, and aircraft.

By the early 1950's, company owned communication wire lines were on the way out.

Today, most pipeline communication is by microwave, leased wire telephone, or teletype. Remote control and "reporting" of stations is usually over leased wire circuits or microwave.

Gathering

The gathering systems that bring the oil from producers' lease tanks to the trunk pipelines have also shown considerable change in 50 years. Early systems used "beam" or "rod line" pumps connected to the producers' equipment. These usually pumped to a central gathering station, which, in most cases, was equipped with steam pumps. Some such installations are still in use today; however, beginning about 1930, high speed diesel and gas engines came into use for gathering service. These usually pump directly to a trunk line station, eliminating the need for central gathering stations.

Many such stations are now equipped with electric motors. These gas engines and electric motor powered gathering units are often automatically controlled.

Measurement

In the early days, the oil in the producers' tanks was delivered to the pipeline by gaging the tank, ordinarily, by the use of a gage pole. The gager was concerned only with the actual volume moved out of the tank, and no sampling was done. No correction was made for temperature or bs&w content, and gravity was seldom recorded. A pipeline allowance of 2 percent was not uncommon.

The more modern methods of measurement now in use, which correct volumes to 60 F, correct for bs&w content and volume shrinkage, together with use of floating roof tanks or floating evaporation "blankets," have made possible pipeline allowances of ¼ of 1 percent common, and some are as low as ⅛ of 1 percent. Manpower requirements have been materially reduced through the use of metering facilities, automatic sampling facilities, and lease automatic custody transfer (LACT) facilities.

During 1954 and 1955, Interstate installed positive displacement meters that made it possible to deliver some 400,000 bbl of oil per day out of the system by meter measurement. Four of these meters are shown in Fig. 13.

Engineering

At the time Interstate's predecessor companies laid the original pipelines in 1909, station spacing and pipe sizing were largely by "rule-of-thumb" methods, based on experience with previous lines. Several empirical formulae on fluid flow had been developed, but hydraulic calculations as we know them were not possible. The work of Stanton and Pannell, about 1914, on the flow of fluids through smooth pipes is generally accepted as the first real advancement in the study of fluid friction problems arising in pipeline engineering practice. This work has been expanded and refined by others in more recent years. Notable among these were W. G. Heltzel in 1926 and H. F. Moody in 1944. These works are the basis for today's hydraulic design engineering of practically all crude oil pipelines.

Since there was so little engineering done in connection with early pipelines, it is understandable that few engineers were employed. It was rather common practice for a new pipeline company to have one engineer, usually borrowed from a parent or affiliated company, whose primary duty was other than engineering.

Pipeline engineering is now a respected profession and is a far cry from the earlier rule-of-thumb methods. It is not unusual to find that 5 percent or more of the total employees of a pipeline company are engineers. The slide rule and hydraulics tables have replaced the rule-of-thumb, and even these are giving way to electronic computers. Any proposed pipeline, large or small, is carefully studied by engineers and, if found to be economically sound, is designed in detail. Routes, materials, and equipment are carefully selected for economy, convenience, and durability.

Manpower is one of industry's most expensive commodities. It then follows that considerable engineering effort must be directed toward maximum utilization of each employee. Early records were not available, but more recent ones show that the number of barrels of oil delivered each day out of one pipeline system per employee is 2½ times as great today as even 10 years ago.

It is only necessary to examine wages and the increased number of higher rated jobs, as compared to lower rated ones, to see how much the individual employee has benefited. This is as it must be because without this kind of progress, no pipeline company can long be competitive and remain in business.

Acknowledgment

Photographs are through courtesy of Standard Oil Company (New Jersey), Interstate Oil Pipeline Company, employees, and annuitants. ★ ★ ★

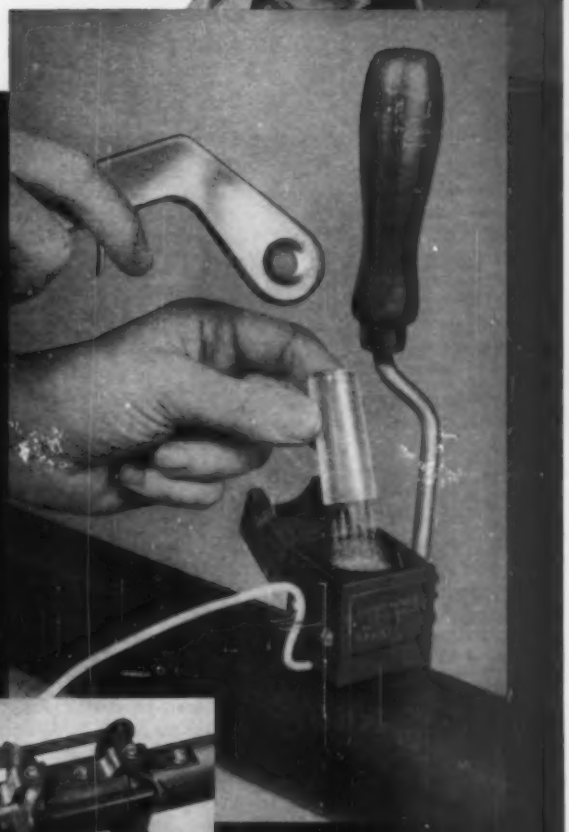
for cathodic protection...

BURNDY thermOweld®

FIRES EVERY TIME!

THE POWDER MAKES THE DIFFERENCE!

THERMOWELD's cohesive starting powder can't mix with the welding charge. This assures full-strength ignition that fires the welding charge every time. Just pour the welding charge from the moisture-tight cartridge into the Thermowelder and tap to release special starting powder. Ignite for perfect, permanent electrical weld connections—anode and header leads, jumper bonds, and other cathodic protection connections.



Anode Leads
Sounder, surer welds

Header Leads
Higher conductivity connections

Jumper Bonds
Easier strap or cable bonds

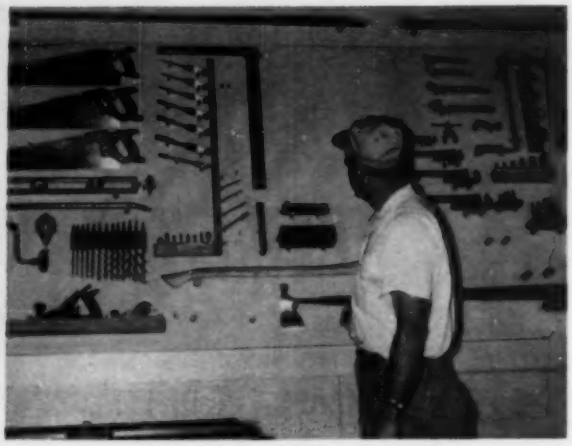
For complete details on softer slag, sure-fire **THERMOWELD** connections for cathodic protection, call your Burndy representative or write: **BURNDY**, Norwalk, Connect.

BURNDY

59-10

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada

Safety engineer using visual aid in the form of a National Safety Council graph.



Excellent example of good housekeeping — a place for every tool and every tool in its place.

Design for a Practical Safety Program

PART 2

Stanley Owens, *Director of Safety, Transcontinental Gas Pipe Line Corporation*

2. EMPLOYEE SAFETY TRAINING MEETINGS

Everyone agrees that safety pays dividends, but what about some of the things that safety does. First of all, a good safety program results in *good employee relations.*

One of the main factors in accident prevention is the attitude of employees. When you improve attitude toward safety, you improve it in general. Employees that are given the opportunity to air their views in a good safety meeting will blow off their steam through this form of safety valve.

Better working conditions and a better attitude toward safe practices means a better attitude toward the company.

Time, money, and effort spent on safety not only prevents accidents, it improves employee relations, and most of this can be accomplished by a good program of system-wide safety meetings held according to a regular schedule.

Most pipeline companies have separate compressor and pipeline departments, which represent the two largest groups in the operating department.

Therefore, the scheduling of safety meetings falls somewhat naturally into two types of meetings — those held among the compressor station personnel and the pipeline maintenance crew. The measurement, communications, corrosion, construction, and engineering department field personnel attend the compressor or pipeline safety meetings in their area.

The compressor stations operate around the clock with shift changes usually at 8:00 a.m., 4:00 p.m., and midnight.

A meeting held at 3:00 p.m. at a compressor station will allow all of the men on the 8:00 a.m. to 4:00 p.m. shift (except one or two required to stand by for operation) and the employees on the next shift who come one hour early, to attend. With proper notice and an interesting program a few from the midnight tour usually will be present also.

All employees should be paid for the one hour that each spends in a scheduled safety meeting. The meeting, of course, should be limited to one hour's duration, opening and closing on time.

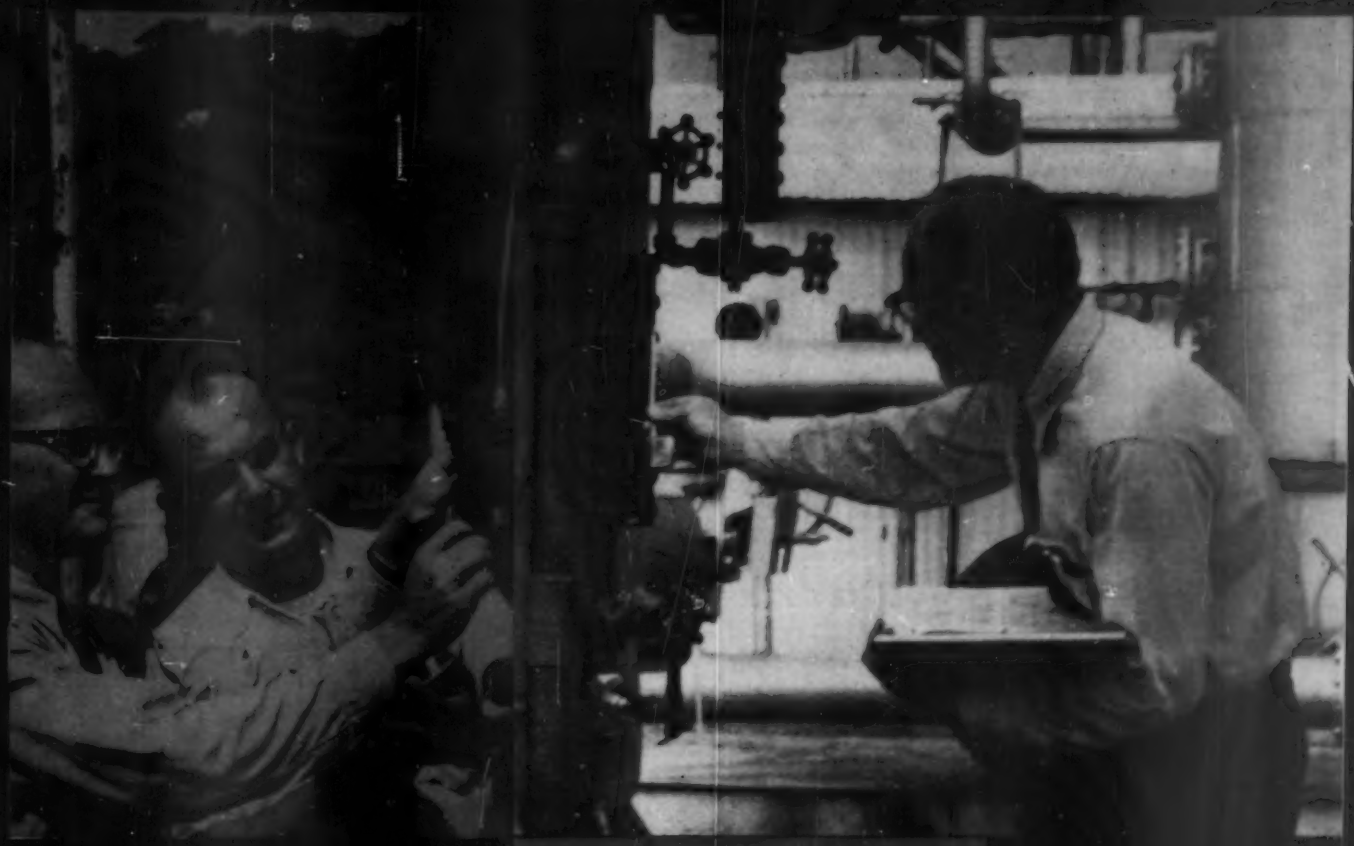
The pipeline crews, usually only working during daytime from 7:00 a.m. to 3:00 p.m. should have their safety meetings scheduled to begin at the start of their work day and finish in one hour.

Any itinerant employees who may be working in the area should be invited and should be required to attend one of the regular scheduled meetings held during each series.

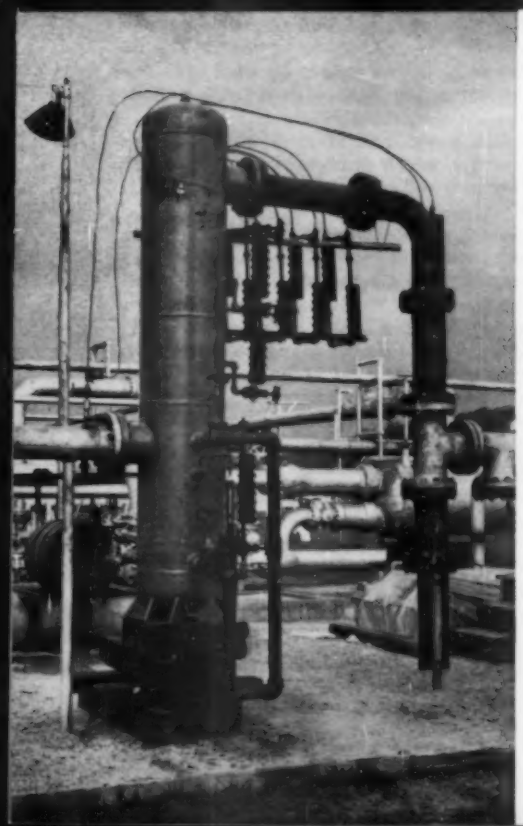
It is good policy to have at least one safety meeting each month for each group of employees. This means that the total number of meetings held per month throughout the system will be the sum of the number of compressor stations and pipeline crews.

The meetings should be planned and scheduled by the Safety Department, and advance notices sent out to each applicable bulletin board on the system.

Herewith are presented five suggested programs for pipeline safety meetings. These are taken directly from Trans-



PROJECT NFX-12



. . . A.G.A.'s giant step toward cleaner gas

You're looking at the test site of a vital research project sponsored by the American Gas Association. Six competitive gas cleaners—including Blaw-Knox—were studied for cleaning and oil loss efficiencies.

It was an important step . . . the first time gas cleaners have been so scientifically and impartially tested. The project set the stage for continuing research to improve gas cleaner performance.

Following the test, Blaw-Knox was the first to build a new pace-setting "Multi-Phase" cleaner. Now proven by our extensive supplemental testing, the Blaw-Knox "Multi-Phase" cleaner surpasses previous performance for low oil loss while cleaning gas of even sub-micron size foreign particles.

Blaw-Knox is proud to have been part of the A.G.A. project. From it comes the best gas equipment in Blaw-Knox's history to assure you of cleaner gas at lower cost. Let Blaw-Knox give you more details. Write . . .

BLAW-KNOX

BLAW-KNOX COMPANY
Buflovak Equipment Division
1563 Fillmore Avenue, Buffalo 11, N.Y.

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

INTER-OFFICE MEMORANDUM

DATE: February 20, 1958

TO: Operating, Engineering, and Construction Supervisors

FROM: Stanley Owens, Director of Safety OFFICE: Safety

SUBJECT: Employee Safety and First Aid Training Program
January - February, 1958 (Southern Section)

Program: (a) Section II - Transcontinental First Aid Training Program, "Artificial Respiration"

(b) American Gas Association Visual Presentation, "How to Lift Safely."

(c) Demonstration of "Lifty" the mechanical safety man

(Meetings will be conducted by Safety Engineer, John L. Smith)

The program of this systemwide series of employee Safety and First Aid Training Meetings, conducted by the Safety Department, will include Section II - Transcontinental First Aid Training Course - "Artificial Respiration" illustrating the "Arm Lift - Back Pressure Method." This will consist of a demonstration by the Safety Engineer, followed by employee participation in the practice and use of artificial respiration.

The second portion of the meeting will be on: "How to Lift Safely," an American Gas Association Safetygraph visual presentation. This illustrates the technical approach to strains to which the body is subjected and methods of working with the muscles instead of against them.

The third portion of the program will include a demonstration of "Lifty," a mechanical model which will illustrate the principles of proper lifting techniques.

Due to the importance of the subjects covered, all field employees from other departments are cordially invited to attend any meeting scheduled in the vicinity in which they are working.

DATE	**PIPE LINE DIST. & CREW	*COMPRESSOR STATION	LOCATION
Wednesday, February 26	3	3	Crowley, Louisiana
Thursday, 27	3	1	24 Gillis, Louisiana
Friday, 28	2	7	4 Sour Lake, Texas
Monday, March 3	2	6	23 Aldine, Texas
Tuesday, 4	2	5	3 El Campo, Texas
Wednesday, 5	1	4	Victoria, Texas
"			2 Refugio, Texas
Thursday, 6	1	2 & 3	Corpus Christi, Texas
Friday, 7	1	1	Falfurrias, Texas

* Meetings will convene one hour before afternoon shift change.
** Meetings will convene at start of work at crew warehouse.

Form of notice to Field Supervision of schedule and program of employee safety training meetings. This is posted on each safety bulletin board.

continental's Employee Safety and First Aid Training Program. Each is outlined on a colored inter-office memo from the Safety Department to all operating, engineering, and construction supervisors systemwide.

Illustrated on this page is a typical announcement of a program, which, of course, includes the time and location of each meeting in the particular section of the system being covered.

The other four programs follow:

Program I

(a) Section I — Transcontinental First Aid Training Program, "The Control of Bleeding."

(b) "Fire Hazard Control" and Fire Fighting Demonstration.

The program of this systemwide series of employee safety and first aid training meetings, conducted by the Safety Department, will include Section I — Trancontinental First Aid Training Course — "The Control of Bleeding," illustrating the latest techniques for controlling venous and arterial bleeding. Recognition of and first aid for physical shock will be discussed. The circulatory system will be reviewed. As in all sections of the Transco first aid training program, the audience will participate in the demonstrations.

The second portion of the meeting will be devoted to "Fire Hazard Control," an American Gas Association Safetygraph visual presentation on the prevention of fires in typical gas industry operations. It illustrates ignition sources and their control. The standard 30-lb dry chemical and carbon dioxide fire extinguishers will be demonstrated and proper methods of refilling and inspecting will be given.

Program II

(a) Section III — Transcontinental First Aid Training Program, "Types and Treatment of Burns." "Heat Exhaustion and Sunstroke."

(b) American Gas Association 35mm color sound film, "Seven Doorways to Death."

The program of this systemwide series of employee safety and first aid training meetings, conducted by the Safety Department will include Section III — Transcontinental First Aid Training Course — "Type and Treatment of Burns," illustrating the three degrees of burns and the latest techniques of treatment, including a demonstration of the Transcontinental Emergency Burn Kit.

Heat exhaustion and sunstroke will be discussed and illustrated by a 35mm sound film strip. An American Petroleum Institute visual presentation will also be employed in this section. Employees present will participate in the demonstrations.

The second part of the program will be the presentation of the American Gas Association film entitled, "Seven Doorways to Death." This film presents a 10-year review of the employee fatal injury experience of the gas industry. It illustrates that all fatal accidents have the same basic cause — *Unsafe Acts and Unsafe Conditions*, or a combination of both.

Program III

(a) Section IV — Transcontinental First Aid Training Program, "Types of Wounds and Bandaging Techniques; Dislocations, Sprains and Strains; Fractures and Splinting."

(b) *Movie* — "Auto Crash Research" — in sound and color.
Movie — "Aim for Safety" in sound and color, on Safety in Hunting.

The program of this systemwide series of employee safety and first aid training meetings, conducted by the Safety Department will include Section IV — Transcontinental Employee First Aid Training Course — "Types of Wounds and Bandaging," illustrating the use of each type bandage found in the Transco First Aid Kit; and "Fractures and Splinting," covering first aid for, and splinting of, the various type fractures.

"Dislocations, Sprains and Strains" also will be discussed.

An American Gas Association visual presentation entitled, "Aw It's Nothing" which emphasizes the importance of treating small wounds and cuts, also will be employed in this section.

The movie, "Auto Crash Research" vividly presents the need for, and advantages of, the automotive seat belt. Through laboratory-controlled automobile crashes, Cornell University has illustrated that the auto seat belt is the best packaging technique for safeguarding today's automobile passenger. Slow motion film records the difference between accidents in which dummies are wearing seat belts and those in which they are not.

"Aim for Safety," a sound movie film in color shows the proper safety procedures that everyone should follow who goes into the woods, fields, or marshlands in search of game. In addition to making many helpful suggestions about equipment and clothing, the film also discusses the care and handling of guns.

During this series of meetings the safety engineer will inspect all first aid kits for completeness, location, and installation.

Program IV

(a) Films — "What Is Your Safety I. Q.?" and "All of a Sudden."

Interest is evidenced by this group for the safety subject being presented. Note the comfortable folding chairs.

(b) Psychophysical Drivers Testing — The "Porto Clinic" equipment will be utilized to demonstrate safety driver testing.

(c) Section V — Transcontinental First Aid Training Program, "Transportation of the Injured and Care of Poison Ivy and Snake Bites."

The program for this systemwide series of safety meetings conducted by the Safety Department, will include a sound movie entitled, "What Is Your Safety I. Q.?" wherein 15 traffic situations are presented from the driver's eye view (from a moving car) and the audience selects a correct solution from three possible choices.

Another film entitled "All of a Sudden," presents the psychological reasons that make people act differently when behind the driver's wheel.

The Psychophysical Driver's Test provides the means of discovering any visual deficiencies present in our company drivers and assists them in correcting them. The test also provides the non-company driver an opportunity to discover any defects in his vision that could contribute to a work injury or to an off-duty automobile accident. These tests will show the driver how to employ corrective habits to overcome physical shortcomings. The unit will test the five basic psychophysical factors: Visual Acuity (sharpness); Color Perception (color blindness); Field of Vision (tunnel vision); Depth Perception (stereoscopic effect); and Reaction Time.

A critique will be given on this method of driver testing. Employees may avail themselves of the opportunity to take the test during the visit of the safety engineer.

The last part of the program will be devoted to the transportation of the injured and care of poison ivy and snake bites. The standard Transcontinental Snake Bite Kit will be demonstrated. Employees present will participate in all first aid demonstrations.

PLANNING THE MEETING

In some companies one of the safety engineers conducts the safety meeting every two months at each location. The meeting held during the alternate month when the safety engineer is not present is conducted by field personnel.

Planning is essential for all good safety meetings and a few minutes of general, haphazard thinking is not enough. There must be sufficient time and effort given to the planning of the program to assure an interesting, constructive, and informative meeting. Generally, the following five points give the formula for planning the meeting.

1. Plan in detail the meeting, the advance publicity, and the promotion.
2. Plan the timing, assign a time limit to each part of the meeting. Open on time; close on time.
3. Prepare an outline of the meeting to serve as a guide.
4. Verify the attendance of everyone on the program and make sure that each program participant knows the part he will take on the program.
5. Check the arrangements of the meeting place, the date, and all other details.

The meeting place should be large enough to accommodate the group. The room should be well ventilated and contain a sufficient number (one for each employee) of comfortable chairs.* Seating arrangements should be made so that all present will be in a position to hear the speaker and see the visual aids.

A table should be provided at the front of the room for any visual aids used.

The employees or others who are to take part in the program should be seated near the front of the room. When called upon, they should walk to the speaker's table and address the group from this position.

If a movie or slide projector is to be utilized, the seats should be arranged so the operator of this machine will have access to an outlet plug. Seats should be arranged so that all present have the best possible view of the screen. The projector and screen should be set up before the meeting, tested, focused and framed so that they are ready for instant use.

Safety engineer demonstrating the proper method of recharging a dry chemical fire extinguisher during an employee safety training meeting.

Material for the safety meeting should be mailed to each location by the Safety Department in advance of the meeting. This material should be reviewed by the chairman and superintendent or foreman prior to the meeting in order to determine which portions are applicable to their particular location and situation.

When prepared materials from the safety publications and other sources are used, they should not take all the time allotted for the program. To have a full, well balanced program, it will be necessary to develop participation among the employees. Group participation is one of the greatest stimulants to interest.

The subjects may be either in connection with the as-

*Transcontinental has purchased one chair for each compressor and pipeline department employee with sufficient extra chairs to accommodate employees of other departments who may be in the area at the time of a meeting. These chairs cost less than $5 each and have proved to be a very good investment in employee and public relations. They are all steel folding type with tubular steel legs and frame, 19 gage double braced. They have safety guard hinges, concave formed steel comfort seat, compound curve posture back, bonderized for rust resistance; with chip resistant, baked enamel finish. These chairs come three to a box and store in a small space.

signed subject for the meeting, or some other local problem may be discussed. Care should be taken to assign a subject to the man who might be best qualified to handle it. It is the job of the chairman to sell others on this idea. The more the group participates, the easier the job for the chairman.

A copy of all talks and papers should be made a part of the safety meeting minutes.

Outside speakers often will contribute much to the interest of the meeting. These speakers may be doctors, lawyers, ministers, highway patrolmen, city or county officials, firemen, teachers, safety engineers, etc. It will be necessary for the safety meeting chairman to get approval of outside speakers from his supervisor before these speakers are officially asked to appear.

When an outside speaker is invited to appear on the program, he should be advised to speak only on the subject announced. He also should be told how much time he will have. The chairman should see to it that no part of the program takes up too much time.

Safety meetings should be well advertised before the date of the meetings. This can be done both by personal contact and through posters or notices on the bulletin board, which give not only the time and place of the meeting, but some of the outstanding features on the program including the speakers and the subjects to be discussed.

CONDUCTING THE MEETING

The meeting should start at the appointed time regardless of number present. This will eliminate waiting for tardy members, will create a more business-like attitude, and will tend to stimulate prompt arrival at future meetings.

All visitors who are not members of the group and who are not on the program should be introduced at this time and any new man who has joined the group since the last meeting should be introduced and welcomed by the entire group.

The major points of the previous meeting should be given by the chairman. They should include:

Subjects discussed.

Recommendations corrected since last meeting.

Recommendations carried over from the last meeting.

Recommendations to be completed before next meeting.

These facts can be developed from the minutes of the previous meeting and from information obtained from the superintendent in regard to actions taken on recommendations. This will eliminate the necessity of reading the minutes.

Good results may be obtained by asking each individual if he has any recommendations to make. All recommendations are then entered in the minutes of the meeting on the special forms illustrated.

All injuries occurring in the locality since the last safety meeting should be discussed with a view to arriving at some preventive measures. The purpose of this is not to fix blame, but rather to determine the cause or combination of causes and to establish remedial measures necessary to eliminate this type injury.

The injuries discussed need not necessarily be taken from the company records. In some cases, outside accidents of an interesting nature might be taken from newspaper reports, or possibly an eye witness to some accident will discuss it before the group.

The American Gas Association publication, "How Injuries to Gas Men Might Be Avoided," could be used.

Employees who are on the program should be properly introduced when they are asked to present their talk or demonstration.

The chairman of the meeting should give an outline of the subjects to be discussed and the results to be expected. The material selected should be well balanced and well thought out through discussions with the superintendent. If possible, the program should include job instruction and demonstrations of work being done or anticipated in the near future. From time to time, it should include topics on seasonal hazards, automotive safety, home safety, public safety, etc.

Proper introduction of a speaker is always important, especially the introduction of a guest speaker. Give the speaker a helpful introduction. You don't contribute much when you turn the meeting over to the speaker without giving the audience some reason why this speaker should be talking to them on the subject.

Here is a good four-point introduction:

1. Why this speaker? It is well to tell the group why a certain person has been chosen to make a talk. Mention something complimentary about him and tell how well qualified he is to speak on this subject. Do Not Give His Name At This Time.

2. Say a few words about the subject to be discussed; talk about the importance of the subject. Do not express your views and opinions; you may tear down your expert's speech before he starts.

3. At this point, it is in order to state whether the audience is to be entertained, instructed, or inspired as the case may be. This gives the group a feeling that they will profit from the talks.

4. Give the name of the speaker clearly. If he has titles, state them clearly and accurately. When doing this, face the audience; do not look at the speaker. He already knows his name and chances are the audience does not. Each speaker, whether a day laborer or the president of the company should be presented with the same courtesy.

The local superintendent or foreman should be called upon for comments at the close of the meeting. He should always be invited to show his interest in the program by offering constructive thoughts and suggestions.

Suggested Safety Meeting Agenda

(One Hour Program)

Introductory remarks by the chairman	5 minutes
Call meeting to order	
Introduction of visitors or new employees	
Explanation of the objectives of the meeting.	
Review of pertinent information from minutes of past meeting and new recommendations	10 minutes
Discussion of hazards considered at the last meeting that have not been corrected.	
Comments of group and its recommendations for correction.	
Call for report of safety committee men and recommendations from other employees.	
Discussion of pertinent accidents resulting in injury that occurred at the location since the last meeting.	5 minutes
Presentation of topics prepared for discussion by members of the safety meeting group.	10 minutes
Material supplied by the safety office, statistical information, or other material that might be of interest.	
Review of statistical information and automobile accidents of interest to the group.	
Visiting speaker, special demonstration, job training topic or visual aid presentation such as motion pictures, charts, posters, or other material of interest.	20 minutes
If the safety engineer is present, this time may be offered to him for presentation of visual aids or information of special interest to the group.	
Discussion by superintendent or foreman	5 minutes
Conclusion of meeting	5 minutes
Summarize highlights of program	
Thank participants	
Adjourn the meeting.	

The use of visual aids is encouraged in meetings. These devices effectively assist audiences to retain information.

Forms used to record activities of safety meeting.

TGPL-889
Rev. 11-58

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

Safety Department

(SAFETY MEETING PROGRAM)

ORDER OF BUSINESS

1. Call to Order by Chairman
2. Signing of Attendance Roster by Employees Present
3. Introduction of Guests and Visitors
4. Reading and Approval of Minutes of Previous Meeting
5. Report of Safety Recommendations on Unsafe Conditions and Hazardous Practices
6. Current Status of Outstanding Safety Recommendations
7. Program
8. Remarks by Visitors
9. Adjournment

This Form may be obtained from Houston Office Stationery Storeroom

TGPL-887
Rev. 11-58

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

Safety Department

(SAFETY MEETING PROGRAM)

Send Original Copy to Safety Department, Houston

ROSTER OF SAFETY MEETING

(To be passed around at meeting and signed by each person present)

Location:
(Compressor Station or Pipe Line District, Crew or Others)_____ Date _____ 19__

This Form may be obtained from Houston Office Stationery Storeroom

TGPL-885
Rev. 11-58

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

Safety Department

(SAFETY MEETING PROGRAM)

Send Original Copy to Safety Department, Houston

MINUTES OF SAFETY MEETING

Location:
(Station or Pipe Line District, Crew or Others)_____ Date _____ 19__

Town _____ Time _____

Attendance: _____ Roster: (Attached)

Speakers: _____

Visitors:

Call to Order:
Reading of Minutes of previous meeting:
Report of Safety Recommendations:

Status of Outstanding Safety Recommendations:

Program of the Meeting:

Adjournment: _____ am / pm Signed _____ Secretary

This Form may be obtained from Houston Office Stationery Storeroom

TGPL-887
Rev. 11-58

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

Safety Department

(SAFETY MEETING PROGRAM)

Send Original Copy to Safety Department, Houston

RECORD OF SAFETY RECOMMENDATIONS

Location:
(Station or Pipe Line District, Crew or Others)_____ Date _____ 19__

No.	

* Code for Numbering Safety Recommendations:
For Compressor Department:
Example: 201-7-11/58
Where the 2 stands for Compressor, the number 1 for the station number, number 7 for the consecutive number of the Safety Recommendation, followed by the date on which the recommendation is made.
For Pipe Line Department:
Example: 105-12-3/11/58
Where the 1 stands for Pipe Line, the number 05 for the Pipe Line District, the number 3 for the consecutive number of the Safety Recommendation, followed by the date on which the recommendation is made.

This Form may be obtained from Houston Office Stationery Storeroom

Any person is more apt to remember something he sees than the things he just hears.

When explaining a job procedure, it is always advisable to use tools and equipment whenever possible. Employees will be better instructed if they can see a demonstration of the use of a piece of equipment and will benefit by actual use of this equipment through practice sessions.

In the preparation and planning for a meeting, the superintendent and chairman should always give consideration to visual aids.

Some suggested aids are:

Charts, diagrams, and schematic drawings.
Safety posters.
Tools and equipment demonstrations.
16mm films.
35mm filmstrips.
Safety flipcharts.
Blackboard illustrations.
Magazines.
Live demonstrations.
Play acting.

RECORDING THE MEETINGS

Recording of the minutes by the safety secretary is an important part of any meeting. Minutes should be prepared and sent into the Safety Department as soon as possible.

A chairman who holds a good meeting but who sends in poor minutes does not receive the credit he is due. The chairman, superintendent, and safety secretary should work together in developing the program and recording the true picture of the meeting in order that a true evaluation of the accident prevention effort may be made of the various locations.

A simple yet comprehensive safety meeting minutes form should be developed, which may very readily be filled out without the use of a typewriter by the safety meeting secretary.

The forms developed by Transcontinental Gas Pipe Line to record safety meeting activities are printed on four separate colored sheets.

The first sheet is an outline of the *order of business* of the meeting, and is found very useful by employees who are handling a meeting for the first time and employees who are recording the minutes of the meeting.

The second form is the *roster sheet* for the safety meeting. There are spaces on this form for the location, unit number (pipeline crew or compressor station) and the date of the meeting. There are 32 lines for employee's signatures. This form is passed around at the start of these meetings for everyone present to sign.

The third form covers the *minutes of the safety meeting*. This form contains the date and starting time of the meeting at the top of the page and the time of adjournment at the bottom of the page. The form also contains space for the meeting location, total number in attendance, names of speakers, names of visitors, status of outstanding safety recommendations, and lastly the program for the safety meeting.

The last form is the *record of safety recommendations*. The date and meeting location are noted on this form along with ruled spaces for safety recommendations. At the bottom of this form is a simple code to be used in numbering the safety recommendations. (This code is shown on the form illustrated).

These minutes, including all four forms, when completed are sent directly into the Safety Department. There they are carefully read, and when recommendations are made that are possible to be put into use, such is done. Sometimes a recommendation is made that is a good one and naturally if it is good in one location it probably will be good throughout the system, so attention must be directed in this matter to advise department heads in the home office to incorporate the recommendation systemwide.

In the possible event a recommendation comes in that can not be used or is not applicable a warm letter is written by one of the safety engineers to the person making the recommendation, advising them of the reason why his recommendation cannot be complied with. This tends to eliminate any hurt feelings and also encourages additional recommendations.

This is a very practical method of recording the meeting agenda and has worked out very well. Further, the minutes, when they have been reviewed by the Safety Department, are assembled each month and bound in a volume and sent to the vice president in charge of operations. He reviews them and notes the attendance as to whether it increases or decreases at different locations. He also gages the interest displayed through the presentation of ideas and the general appearance of the minutes. In this manner, he can keep his finger on the pulse of the safety meeting program.

To be continued in an early issue

DESTINATION: TOMORROW!
TODAY THE E/4 SHOULDER HOLIDAY DETECTOR AND THE E/P PULSE TYPE DETECTOR FOR DAMP CLIMATES ARE ANSWERING THE PIPELINER'S NEED FOR A DEPENDABLE, FULLY PORTABLE, GENERAL PURPOSE, ELECTRICAL INSPECTION INSTRUMENT.
BOTH MODELS CAN BE USED FOR A FULL DAY WITHOUT RECHARGING THE BATTERY. ALL WRAPPED SURFACES INCLUDING PIPE CAN BE QUICKLY AND ACCURATELY INSPECTED FOR VOIDS, PINHOLES, BREAKS, SCRATCHES AND BURNED OR COKED SPOTS
TOMORROW THESE SAME DETECTORS WILL BE USED IN THE INSPECTION OF TUBING ON OUTER SPACE ROCKETS. FOR TINKER & RASOR DETECTORS ARE DESIGNED FOR THE FUTURE.
DISTRIBUTORS
Crutcher-Rolfs-Cummings Inc. Houston, Texas
Ramco Manufacturing Co., Inc. Tulsa, Oklahoma
Canadian Equipment Sales & Service Ltd. Edmonton, Alberta, Canada
Bob Herrick Rentals & Service Harrisburg, Penna.
Falcon Line Products Corp. Elizabeth, N.J.
Export Agents . . . Frazer & Hansen Ltd. San Francisco, Calif.
Electronic Detectors for every Industry
J. R. TINKER & RASOR
417 AGOSTINO ROAD, P. O. BOX 281, SAN GABRIEL CALIFORNIA

SUBSCRIPTION ORDER FORM

***Pipeline Engineer*, Box 1589, Dallas 21, Tex**

(Enter) (Renew) my subscription for —

1 year..$3.00 ☐ 2 years..$5.00 ☐ 3 years..$6.00 ☐

*Name*_____

*Company*_____

*Position*_____

*Home Address*_____

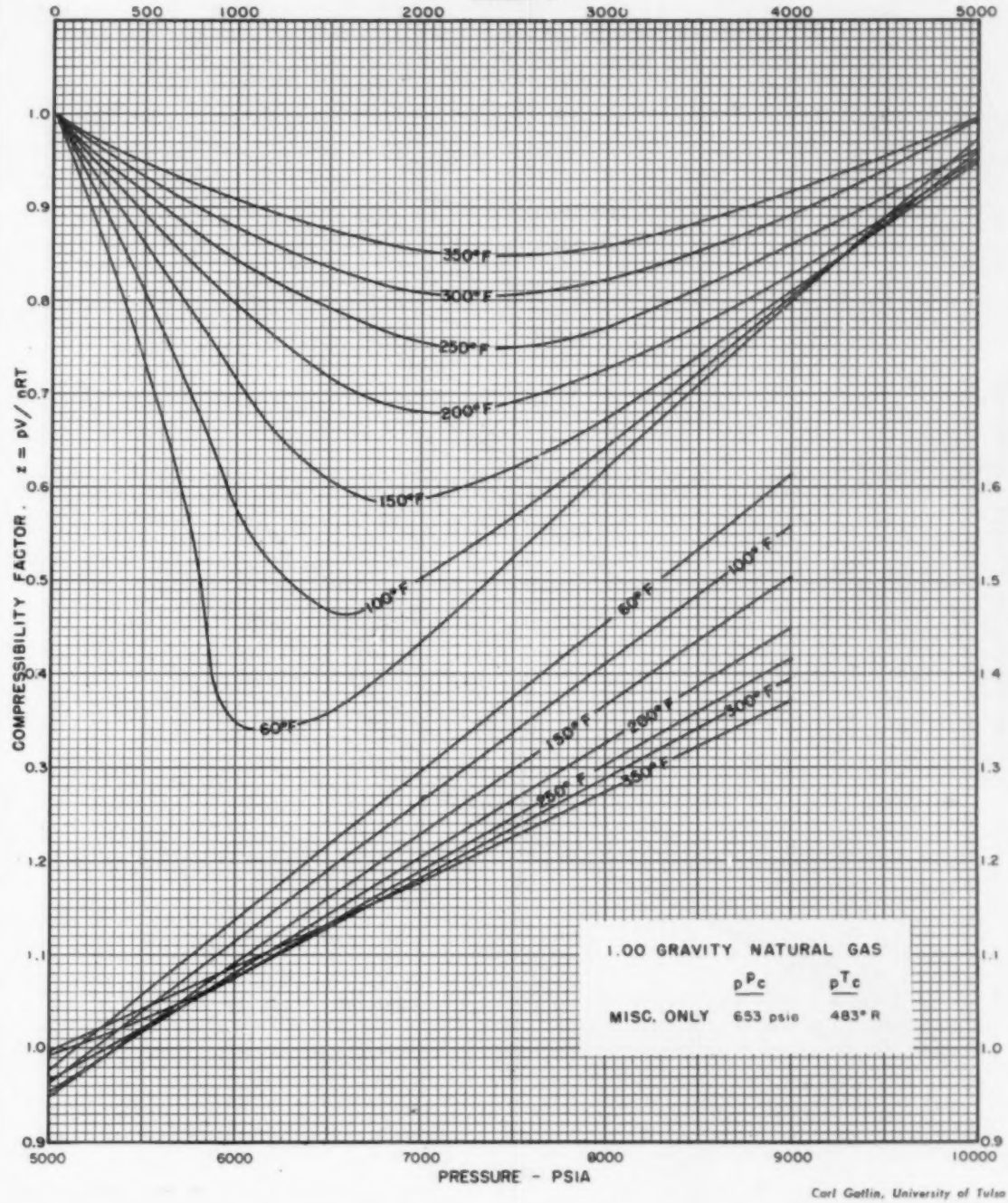
*Office Address*_____

*City*_____ *State*_____

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

SIMPLIFIED COMPRESSIBILITY FACTOR CHARTS FOR NATURAL GAS CALCULATIONS

CHART 7

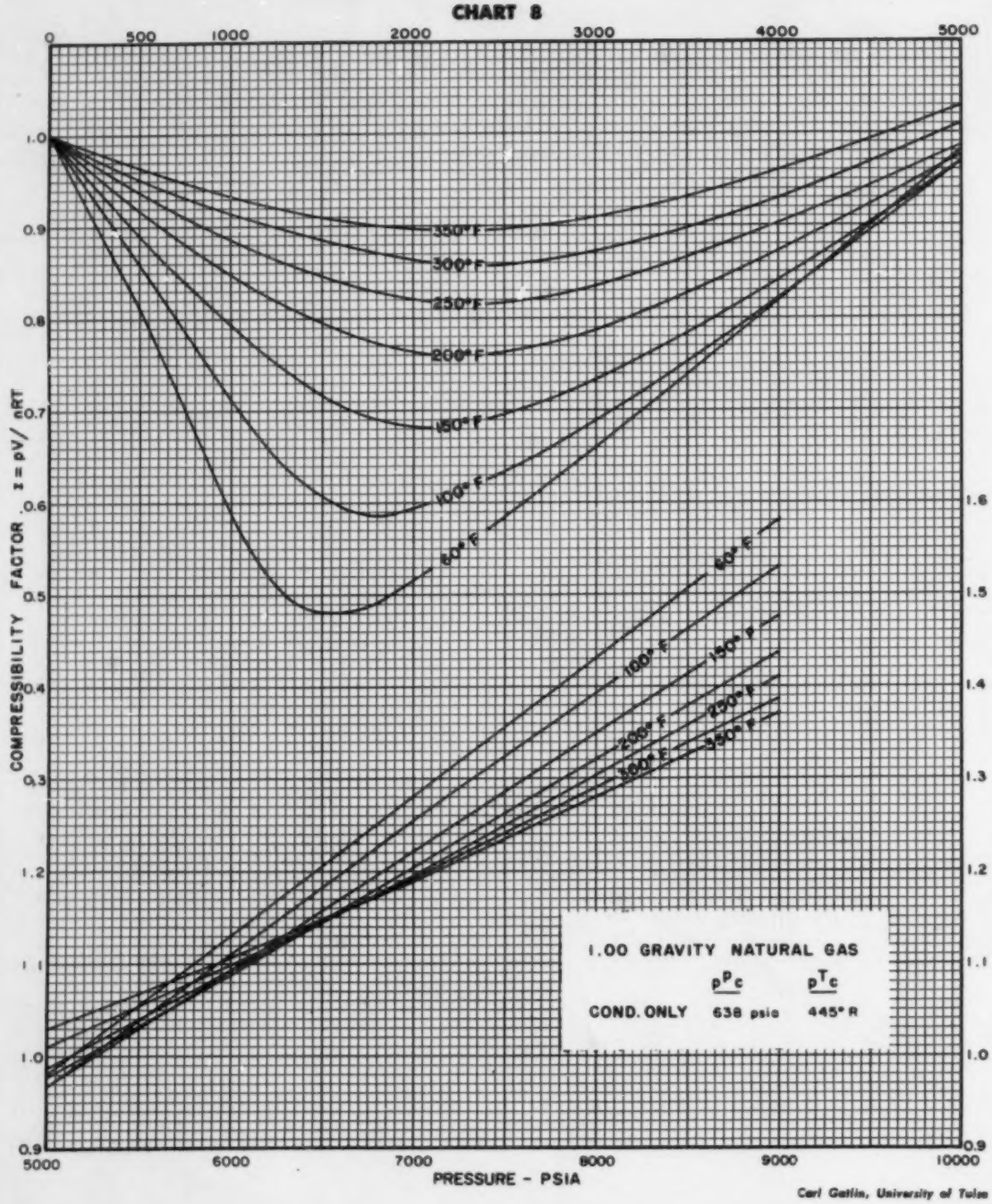


Carl Gatlin, University of Tulsa

PIPELINE HANDBOOK **DATA SHEET** FILE UNDER: *Natural Gas Data*

SIMPLIFIED COMPRESSIBILITY FACTOR CHARTS FOR NATURAL GAS CALCULATIONS

CHART 8



Carl Gatlin, University of Tulsa

Can Small-Diameter Pipelines Compete with the Large-Diameter?

Here are the results of a study by the writer, which reveal pertinent data on this subject and raise some questions as well

Harry G. Schad, *President*
Atlantic Pipe Line Company

A MATTER of no small moment to operators of so-called small-diameter pipelines is the question of the economic life of the line. A corollary question is how well, if at all, these smaller pipelines can compete with new large-diameter facilities.

Another important consideration is related to the time when it becomes advisable to abandon the smaller facilities and invest in newer and larger systems.

By smaller pipelines we are talking in terms of 6 in. and 8 in. such as were built in the 1930's for use principally as petroleum products carriers. The discussion that follows proposes to take a look at some facts of this overall

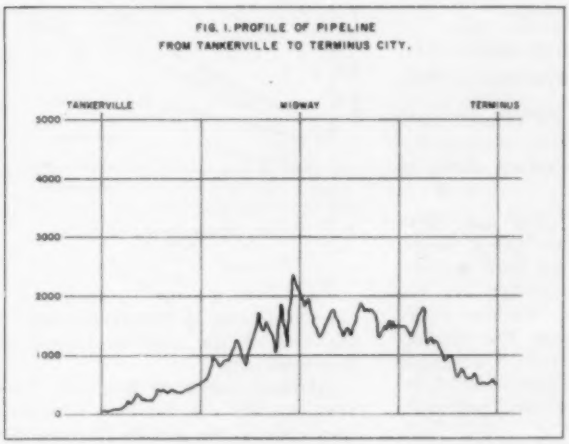


FIG. 1. PROFILE OF PIPELINE FROM TANKERVILLE TO TERMINUS CITY.

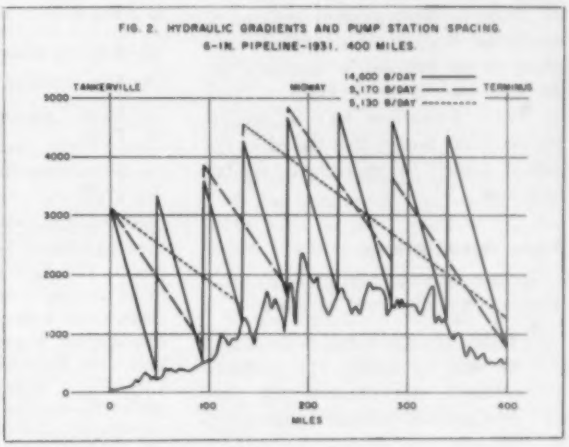


FIG. 2. HYDRAULIC GRADIENTS AND PUMP STATION SPACING. 8-IN. PIPELINE-1931. 400 MILES.

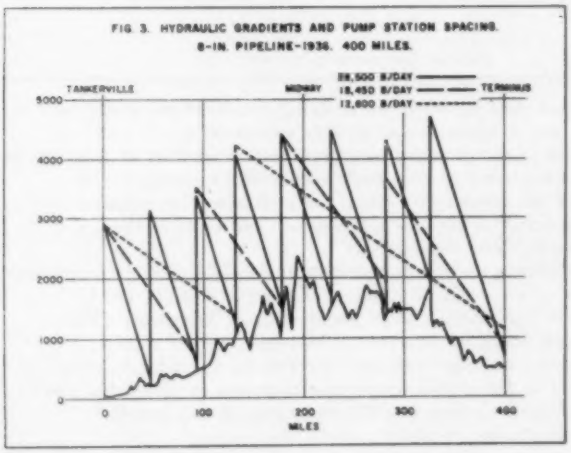


FIG. 3. HYDRAULIC GRADIENTS AND PUMP STATION SPACING. 8-IN. PIPELINE-1936. 400 MILES.

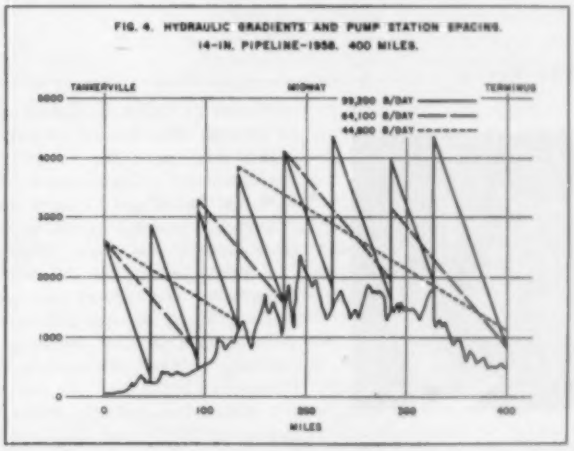
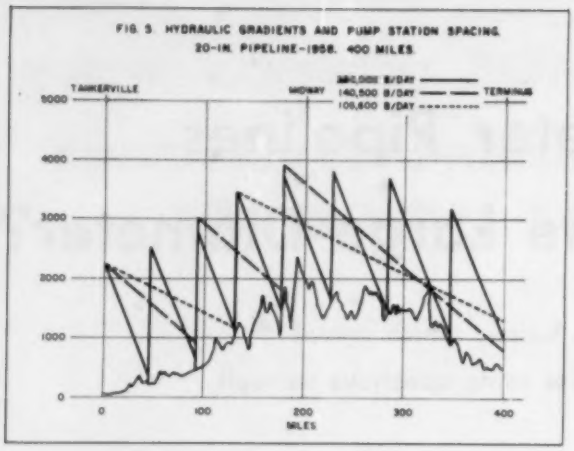
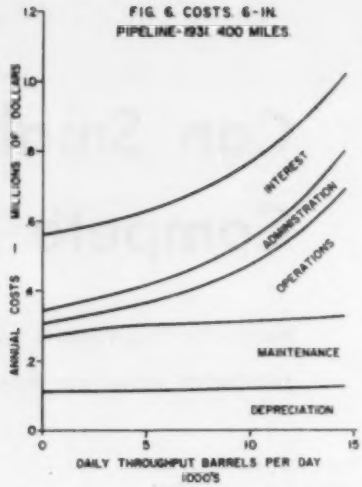
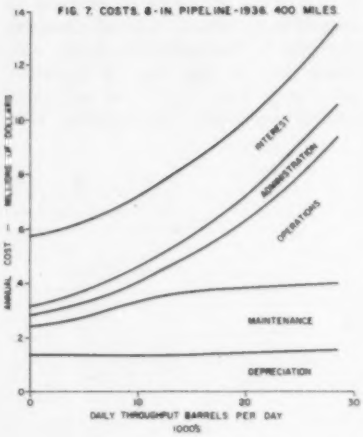


FIG. 4. HYDRAULIC GRADIENTS AND PUMP STATION SPACING. 14-IN. PIPELINE-1958. 400 MILES.







question. While it is obvious that general observations cannot apply specifically to any given problem of this nature, perhaps in this article we can come to some conclusions regarding the ability of these relatively small-diameter pipelines to compete with the more modern large-diameter systems.

One obvious advantage enjoyed by the older product pipeline systems is the lower original construction cost. Many of the systems in operation today were built in the period from 1930 to 1940. Inflation has increased markedly the money that would be required today to reproduce similar facilities.

Basic Assumptions

To approach our subject, some arbitrary assumptions must be made:

1. That a pipeline when built should be able to handle (in products service) approximately 100 percent growth without a line-looping job.
2. That any comparison made would assume the same degree of automation in both pipelines.
3. That the pipeline and equipment on any of the projects studied would be maintained to the same excellent degree.

What Is Proposed

Based on these premises, I propose to compare the following:

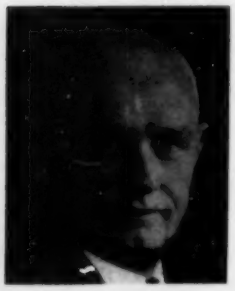
a. 6-in. pipeline system built in 1931,
b. 8-in. pipeline system built in 1935,
c. 14-in. pipeline system built in 1958,
d. 20-in. pipeline system built in 1958.

All construction costs used have been calculated on the basis of period prices. The pipeline has been assumed to be serving a metropolitan area 400 miles from a seaport. We have called this seaport Tankerville. The distribution area has been named Terminus City. Fig. 1 shows a hypothetical profile of the terrain between Tankerville and Terminus City.

In order to simplify the study, we have assumed that all petroleum products originating at Tankerville flow to the end of the pipeline system at Terminus City.

Although complete hydraulic data were worked out for each situation, only four of the profiles showing the location of pumping stations and the hydraulic gradients are reproduced

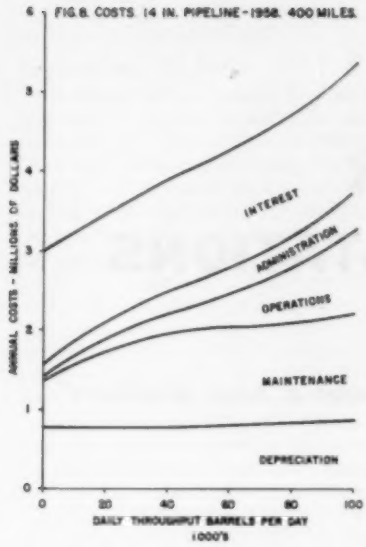
The Author

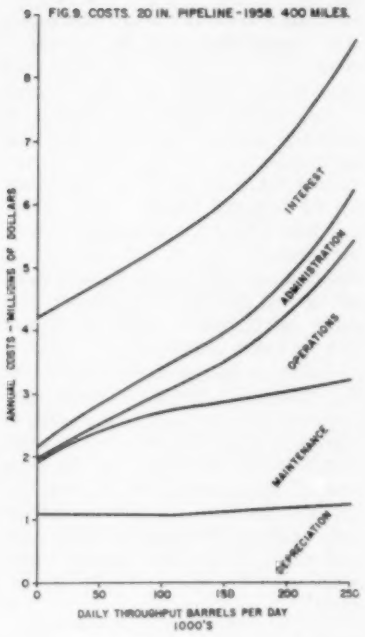


Activities of Harry G. Schad, other than his main job of being president and a director of Atlantic Pipe Line Company, are so numerous as to defy enumeration in a limited space. He is a member of the principal transportation committees of API and has been awarded a Certificate of Appreciation by that body, has been a member of the National Petroleum Council, and the Petroleum Industry War Council, to mention only a few. His untiring efforts in industrial, technical, professional, and civic affairs have brought him many other awards and recognitions.

Schad joined The Atlantic Refining Company organization in 1925 in the transportation department. He became manager of the traffic division of this department in 1933 and was made general manager of the transportation department in September 1941. Subsequently he was elected to the board of directors (1943) and made a vice president in 1945. Meanwhile he also had been elected a director of the Atlantic Pipe Line Company (1937) and was elevated to the presidency of that company in December 1945.

Schad was graduated from Girard College in 1920 and received the honorary degree of LLD from Bucknell University in 1958.





here. Fig. 2, 3, 4, and 5 show this information, and the titles describe what is illustrated by each curve sheet.

It was assumed that electric motor-driven centrifugal pumps would be used, as this type equipment lends itself more readily to automation.

Power costs were assumed to be equal without respect to location, but appropriate schedules were used to determine the cost per kilowatt-hour with relation to the bloc of power purchased.

Calculations on product requirements at Terminus City were based on the normal growth rate of the usage of petroleum products. The rate used in this article assumes a growth in demand equal to 50 percent in every decade.

In order to facilitate an analysis of the separate pipeline systems at various flow rates, a graph was prepared for each of the four systems under study. Reference is directed to Fig. 6, 7, 8, and 9, which shows the development of annual costs for various flow rates.

What Graphs Are Based On

A word about the preparation of the graphs:

Depreciation has been calculated at a composite rate of 3.2 percent (ICC).

Maintenance covers the cost of maintaining the pipeline, pumping stations, and communications equipment, as well as ad valorem taxes.

Operations include the costs of power, a minimum of pumping station personnel, dispatching effort, and delivery supervision.

Administration costs are general office, accounting, and other overhead.

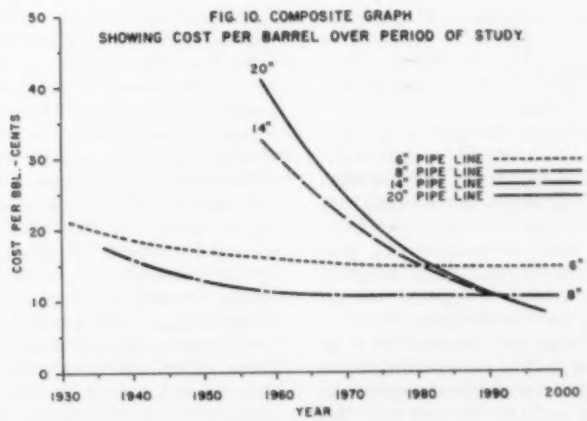
Interest has been figured at 6 percent and is shown separately.

The assumption was made that the entire cost of the project would be financed. No attempt is made to show tariff rates required to produce income, nor are profits or federal income tax included in any of the calculations.

In order to provide for the amortization of the debt, there has been included in the calculations a debt reduction equal to 25 percent of the project in each 10-year period.

The source of the funds for the repayment of the borrowed money was presumed to be the depreciation cash account. Note that not all the depreciation cash was earmarked for this purpose.

In preparing these data, wherever added capital was required for the purpose of increasing or re-arranging the pumping stations, the increased capital costs were included but the graphs were drawn so as to produce a smooth curve.



Conclusions

Fig. 10 is a composite graph showing the cost in cents per barrel for each of the systems over the period of time covered by the study.

I think the first observation that can be made is that small-diameter pipelines built when construction costs were low can compete very definitely with large diameter pipelines built in the late 1950's when construction costs were much higher. Further, the average cost per barrel over the period studied shows little change in the cases of the smaller diameter pipelines.

If the 6-in. diam pipeline is compared with the 14-in. and 20-in., the larger pipelines have to be in operation for 22 years before the costs per barrel are equal.

If the 8-in. diam pipeline is compared with the 14-in. and the 20-in. diameter lines, the larger lines do not equal the 8-in. line costs for 32 years after the start of operations of the larger lines.

Over the years, inflation has had a marked effect on the cost of transportation by pipeline. Pipeline operators take pride in the continuing tariff reductions that they have been able to make over the last 20 years. Perhaps the discussion presented here seems to say that for the future important technological improvements will be necessary just to hold tariff rates at their present levels.

Finally, does this analysis seem to indicate that pipeline operators of 20-year-old products systems who may be planning the installation of new and larger pipelines should consider very carefully the effects such installations will have on tariff rates? Should the very vital matter of the present system's contribution profit-wise and the real cost of abandonment of useful facilities be considered? ★ ★ ★

FIRE PROTECTION FOR UNATTENDED PUMP STATIONS

Increasing number of these stations has brought about a new problem

Glenn L. Ladd
Chief Electrical Engineer
Sinclair Pipe Line Company

UTILIZATION of the unattended pump station in pipeline operations has brought about new problems, and make more complex some of the old ones. Prevention of, and protection from, explosions and fires is of the latter category.

Fire has been an important element in the progressive growth of mankind. It has made his food more palatable, furnished heat for his comfort, provided light, and made possible the many manufacturing processes so vital to his economy.

Fire also has been detrimental. Its careless use has caused billions of dollars in property loss, heavy damage, and loss of life.

What May Happen

The fire problem at an unattended station is the same as at an attended station. Three necessary elements for a fire are present at both: Oxygen, fuel, and heat. The difference is that, in case a fire does occur at an unattended station, there is no one present to prevent it from spreading or to put it out. This fact has made the problem more complex or, to say the least, it has brought about such questions as: What would happen in case a fire did occur, or, what chances are there for a fire to take place and what can be done about it?

Actually, we know the answers to these questions as experience has taught us that fires can and do occur. They have happened in well designed stations where approved equipment and methods of construction have been used to prevent their occurrence. We know also that these same fires have cost the industry plenty of money and, in some instances, loss of life.

Regardless of the type of station, in designing for safety from fire, it is mandatory that equipment such as pumps, valves, tanks, and piping meet rigid specifications as to working and shut-in pressures.

What to Do

At the unattended station, special precautions should be taken in regard to pump seal leakage, pressure release valves, and sump tank equipment. Every effort should be made to prevent petroleum or petroleum products or vapors escaping into the station atmosphere. If this can be prevented, there is no fuel for a fire.

Heat, a source of ignition to set a fire, can be developed in several ways: By electrical equipment, friction from abnormal operation of bearings, dry pumps or pump seals, and use of unapproved tools by maintenance personnel. Thought also should be given to outside sources of ignition such as grass fires, careless smokers, etc.

In the design and construction of an unattended station, precautions should be taken that the electrical equipment and wiring methods used are such that any electric arcs or sparks that may occur cannot come in contact with explosive vapors that may be present. I would like to stress this. At the present time, there is a growing trend to question what constitutes a hazardous or explosive area and the use of electrical equipment and wiring methods approved for such areas as interpreted by the National Electric Code. There are those who, for economical reasons, are willing to take a calculated risk and design along lines not so rigid as those set up by the National Electric and other safety codes. Such a risk can only be based upon three assumptions: (1) That no explosive vapors will ever be present, (2) that no source of ignition can ever exist, or (3) in case of vapors or an ignition source do exist, that they will never occur at the same time. This is mentioned as food for thought, because how close a designer follows the requirements of existing fire and safety codes may depend somewhat upon his management's requirements.

Location a Factor

Other deciding factors are the size and location of the station under consideration. For instance, a calculated risk might reasonably be economically justified for a station of small capacity located in an uninhabited area. Here, if a fire did occur, only a few thousand dollars worth of equipment might be lost, and the possibility is good that the station would operate its full life span at a considerable saving in construction cost. In case of a larger station, or a station located in a congested area where damage costs would be greater, or the design and construction would come under local safety code jurisdiction, the risk cannot be taken and the designer is forced to adhere strictly to

Presented at 11th Midyear Meeting, Safety and Fire Protection Committee, American Petroleum Institute, Denver Colorado.

the safety codes, with considerable increase in construction cost.

Precautions to Take

As no one will be present to push a stop button or close a valve in case trouble should develop, special precautions must be taken that safety and reliability will be paramount in the operation of the unattended station. This can be achieved by the utilization of instrumentation and actuating equipment to perform automatically any desired operating function. For example, ignition from heat set up by friction in abnormal operation of a bearing, dry pump or stuffing box seal, can be prevented by the use of temperature measuring devices so installed and adjusted that they will anticipate any abnormal temperature rise and shut the pumping unit down. In this manner, it can be so arranged that the pump units will clear themselves automatically from the line if any of the specific failures listed below occur in the local pumping equipment:

a. High pump bearing temperature.
b. Excessive unit vibration.
c. High pump case temperature.
d. Excessive shaft seal leakage.
e. High motor bearing temperature.
f. High motor stator temperature.
g. Motor overload current.
h. Motor under voltage.
i. Phase unbalance.
j. High line pressure.
k. High discharge pressure.
l. Low suction pressure.
m. Incomplete starting sequence.
n. High station sump tank level.

Such failures can be indicated on a local control panel for future reference by maintenance personnel and can be telemetered to a remote control point if so desired. The above list is not intended to be complete, as they will vary somewhat with the number of pumping units involved, operational methods, or personal opinions of the designer.

Automatic Equipment Needed

It has been general practice to provide some type of fire control equipment at the attended station. This practice is being carried over to the unattended station on the assumption that someone might be present at the station or close enough to get there in case a fire takes place. **It would appear that a safer and more reliable protection system would be obtained if automatic equipment was used.**

Automatic fire detection and control equipment is available and has withstood the severest testing and examination possible. Its use has proved reliable and has become established for effective industrial and commercial fire protection.

It is not my intention, at this time, to discuss any particular type of automatic fire protection equipment; however, in general, the equipment consists of fire sensing elements or detectors located at various important points in the station. Should fire occur at any of these points, the detectors will actuate automatic extinguisher equipment to control the fire.

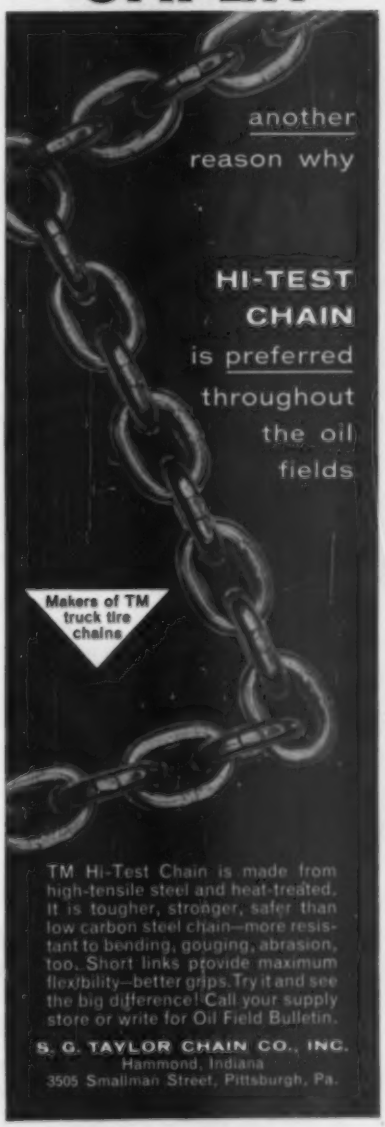
Extinguisher equipment generally consists of large cylinders of carbon dioxide connected to a piping system, through which the inert gas, under its own pressure, floods the fire through multi-jet nozzles. Carbon dioxide reduces the oxygen in the atmosphere and will smother a fire in seconds. Experience has proved carbon dioxide to be ideal for fire protection in pump stations. It is an inert gas, thereby being a non-conductor of electricity and, as it is absorbed by the station atmosphere, it leaves no mess to be cleaned up.

The system should be designed and so arranged that the operating power supply, detector units, detector and actuating unit circuits, and alarm circuits will be supervised automatically. This will assure that open or shorted detector circuits will not cause false operation of extinguisher equipment or give unnecessary alarms.

It is felt that if reasonable precautions are taken, and existing fire and safety codes followed in the overall design of an unattended pumping station, the possibility of a fire occurring is unlikely. To provide additional protection, the use of available automatic fire detection and control equipment can be utilized. It would appear that the use of such equipment would depend upon the following points: Advantage of additional safety, protection of equipment investment, and prevention of damage and shutdown costs. These advantages would have to be carefully weighed and considered to justify economically the additional cost of the special equipment. ★ ★ ★

Glenn L. Ladd, *chief electrical engineer, Sinclair Pipe Line Company, Independence Kansas, has been actively engaged in electrical design and supervisory control problems connected with pipeline pumping stations since 1951. Prior to joining Sinclair Pipe Line, Ladd, occupied the positions of installation and maintenance engineer with the Arrow Drilling Company and electrical engineer with the Sinclair Oil and Gas Company. He was graduated from Oklahoma A & M College, Stillwater, Oklahoma, in 1932 with a BS degee in electrical engineering. He is a registered professional engineer and a member of the AIEE and NACE.*

TOUGHER
STRONGER
SAFER



TM Hi-Test Chain is made from high-tensile steel and heat-treated. It is tougher, stronger, safer than low carbon steel chain—more resistant to bending, gouging, abrasion, too. Short links provide maximum flexibility—better grips. Try it and see the big difference! Call your supply store or write for Oil Field Bulletin.

S. G. TAYLOR CHAIN CO., INC.
Hammond, Indiana
3505 Smallman Street, Pittsburgh, Pa.

Taylor Made CHAIN SINCE 1873

D-73

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Canadian News Notes

Contract Awarded for Alberta Trunk Extension

The largest single pipeline construction project of 1959 in western Canada has been awarded to Mannix Company, Ltd., Pipeline Division, of Calgary. It is 122 miles of 30-in. natural gas pipeline for The Alberta Gas Trunk Line Company, Ltd., representing an extension of the company's main line from Princess Junction to Torrington, in the central plains. This will provide facilities for taking in several new fields, with laterals to be awarded later under separate contracts.

Trunk Line, through its general manager, James C. Mahaffy, Q. C., also announced the award of three more contracts, all to Marine Pipeline and Dredging, Ltd., Vancouver, covering the major laterals and a large river crossing. A 46-mile 16-in. line from Torrington Junction to the Nevis gas field is the first of these contracts, and a 33-mile 16-in. line from Torrington Junction to the major Carstairs gas field is the second. The river crossing consists of 1000 ft of 16-in. line under the Red Deer River near Nevis.

Scheduled completion date is the end of September, including testing. The 30-in. pipe, supplied by Page-Hersey Tubes, Ltd., Welland, Ontario, has mostly been delivered and is stored at rail points near the right-of-way. The smaller pipe is being rolled by Alberta Phoenix Tube and Pipe, Ltd., in its Edmonton mill.

The laterals, still to be awarded, will complete the 1959 construction program for Alberta Trunk, which involves estimated capital expenditures totaling about $23,000,000. Additions to the system are required to meet estimated delivery schedules of Trans-Canada Pipe Lines, Ltd., which is by far the largest individual customer of Alberta Trunk. Trans-Canada requested the construction of the additional facilities last fall. Engineering has been done by Alberta Trunk staff, in consultation with the Trans-Canada engineering department.

Canadian Western to Spend $5,700,000 on Construction

Canadian Western Natural Gas Company, Ltd., will spend $5,700,000 on its 1959 construction program, according to announcement by general manager Harry M. Hunter. Five local communities along the route of its new main 16-in. line from the Carbon gas field to Calgary are included in the new services. Three southern Alberta communities will also be added if arrangements can be made with the Alberta Gas Trunk Line Company, Ltd., and four more are under consideration in this connection.

Cost of new transmission and distribution lines is estimated at $2,300,000. Addition of 4100 city services will require expenditure of $900,000. Improvements to transmission lines and distribution mains, including new meters, will cost $1,200,000. Another $1,000,000 will go for five new Carbon field wells and gas to be purchased for intermediate storage in the Bow Island field.

pipeliner . . .

. . . the "make-or-break" factor in pipelining

Sheehan pipeliners . . . from cat-skinner to spread superintendent . . . have years of experience on every type of line — in every type of terrain. These "old hands" combine the best in heavy-duty modern equipment with the most up-to-date methods to give you a successful job.

Sheehan SPREADS...
the mark of quality
in pipeline construction

SHEEHAN

NATIONAL BANK OF TULSA BUILDING
TULSA, OKLAHOMA

CONSTRUCTION

FEATURE

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Pipeline Projects

CONSTRUCTION

FEATURE

"Budget" Construction Okayed For 4 Companies

A total of $12,500,000 and four natural gas pipeline companies are involved in "budget-type" construction proposals for 1959 recently approved by the Federal Power Commission.

El Paso Natural Gas Company will construct 4½ to 20-in. field lateral lines, compressor facilities varying from 300 to 1600 hp, purification and dehydration facilities, and gasoline plant facilities, at a total cost of $5,000,000, with no single project exceeding $500,000.

Lone Star Gas Company will construct and operate lateral lines and related field facilities in Texas and Oklahoma, with the cost of each single project limited to $250,000 and the total cost of $1,000,000.

Texas Eastern Transmission Corporation received authority to construct facilities in Texas, Louisiana, Mississippi, and Illinois, at a total cost of $4,000,000, with no single project exceeding $500,000.

Columbia Gulf Transmission Company will construct facilities, at a total cost of $2,500,000, with no single project exceeding $500,000, to connect to its pipeline system new supplies of gas purchased by its affiliate, United Fuel Gas Company.

New Iranian Crude Line

A 103-mile, 4-in. crude oil pipeline, with four pumping stations, will be constructed in Iran, from Kalantar to the Kermanshah refinery in southern Kurdistan. Contractor is the Entrepose Company of France, constructors of the Trans-Iranian pipeline.

Coastal Asks to Increase Horsepower, Add Laterals

Although its system from McAllen, Texas, to Baton Rouge, Louisiana, is just going into operation, already Coastal Transmission Corporation has applied to the Federal Power Commission for expansion. Coastal delivers gas to its sister company, Houston Texas Gas and Oil Corporation, for transportation and distribution in Florida, and would increase these deliveries by 335,000,000 cu ft a day.

Requested installations include pipeline laterals and compressor facilities costing an estimated $6,250,000. Proposed is a new 2200-hp compressor station near Port Lavaca, Texas, 1500 additional horsepower at each of its four stations, and supply laterals costing about $2,917,000.

The complete story on the Texas-to-Florida pipeline constructed by Coastal and Houston Texas appears elsewhere in this issue of *Pipeline Engineer*.

Temporary Okay For 80 Miles Of Lines

The Manufacturers Light and Heat Company has received temporary authorization to construct approximately 60 miles of 20-in. pipeline, and Hope Natural Gas Company has received temporary authorization to construct approximately 20 miles of 24-in.

Manufacturers' facilities, costing $5,380,000 and including a 700-hp portable compressor station, will be located in Pennsylvania. The proposal also includes the abandonment of five parallel 6-in. lines totaling 135 miles.

Hope's $2,134,700 proposal, in addition to the transmission line which would replace two 16-in. lines the company plans to abandon, includes two metering stations in Wetzel and Monongalia counties, West Virginia.

Bavarian Line Considered

Justification of a Bavarian crude oil pipeline is currently under study according to a report from the Bavarian Minister of Economics and Transportation. Whether a pipeline should be laid to Bavaria, what route it would take, what minimum quantity of petroleum would justify erection of a refinery in Bavaria, and where the refinery should be built are some of the problems under consideration. The cost of such a project, including a refinery, is estimated to be approximately $143,000,000.

The Marseilles-Lyon-Strasbourg or Karlsruhe oil pipeline, planned to be constructed in the near future *(Pipeline Engineer,* May 1959), apparently brought on consideration of the Bavarian pipeline. Bavaria's supply of oil from the Near East is expected to be considerably improved at reduced costs through the Marseilles-Strasbourg line. It is further expected that oil from the French Sahara will be increasingly insignificant in Bavaria's supply. Other pipelines outside Bavaria being considered are: From Genoa, Italy, to Aigle, Switzerland, where a refinery would be erected; and a direct pipeline from Venice through the Brenner Pass and Innsbruck to Munich.

Northern Natural Expansion Okayed

An examiner's decision authorizing Northern Natural Gas Company to construct 103 miles of main pipeline loops, an 18-mile extension of an existing lateral, and additional horsepower in compressor capacity has been adopted by the Federal Power Commission.

The facilities will increase the company's transmission system capacity by approximately 100,000,000 cu ft of natural gas daily, enabling it to provide 50,000,000 cu ft daily to one proposed new customer, Northern Illinois Gas Company, and 49,891,000 cu ft daily to 23 existing customers.

Two projects are involved. One, estimated to cost $8,223,200, includes 46 miles of main pipeline loops, an 18-mile extension of an existing lateral, and an additional 6000 hp in compressor capacity in Illinois. The other project, estimated to cost $7,733,300, includes 57.4 miles of main line loop additions in Iowa, Nebraska, and Kansas, and 8000 hp in main line compressor additions in Kansas and Nebraska.

Equitable Seeks To Increase System

Pipeline and compressor facilities estimated to cost $1,250,000 in West Virginia and Pennsylvania are involved in an application by Equitable Gas Company which has been accepted for filing by the Federal Power Commission. About 12½ miles of pipeline would parallel a section of the company's existing system in Harrison and Marion counties, West Virginia.

The proposed facilities, including an 880-hp compressor unit at Equitable's Pratt station in Greene County, Pennsylvania, would increase the deliverability of the company's present gas supply system by 12,000,000 cu ft per day.

Projects

Projects Filed To Bring Canadian Gas To Midwest

Midwestern Gas Transmission Company, proposing to serve the Midwest with Canadian gas through a 504-mile 24-in., $52,277,000 pipeline, has filed a new application with the Federal Power Commission, along with an application by Michigan Wisconsin Pipe Line Company for facilities to take its portion of the gas for new service in Wisconsin and the Upper Peninsula of Michigan.

Midwestern's proposal includes the transportation and sale of about 200,000,000 cu ft per day obtained from Trans-Canada Pipe Lines, Ltd., at the Minnesota-Canadian border near Emerson, Manitoba. The proposed line would terminate at a point near Marshfield, Wisconsin, where 158,000,000 cu ft per day would be sold to Michigan Wisconsin. The new system would not be connected to the 350-mile, 30-in., $50,815,000 Portland, Tennessee-Joliet, Illinois system, which has recently been approved by FPC.

Michigan Wisconsin's proposal includes an extension of its existing system from Appleton, Wisconsin, to Marshfield where it would take the gas from Midwestern. Cost of its proposed facilities would be $24,177,000.

Buckeye System Increased

The Buckeye Pipe Line Company is constructing an 11-mile lateral line from its Syracuse-Utica pipeline to the Griffiss Air Force Base at Rome, New York, as part of a program to increase the capacity of its eastern products pipeline system, which extends 437 miles from refineries and deep water terminals in New Jersey to marketing areas in Pennsylvania and New York.

Further expansion plans call for: A booster station at Flemington, New Jersey; pump changes at Macungie, Lehighton, and Nicholson, Pennsylvania; an additional 800-hp pumping unit at Nicholson; a remotely operated booster station at Maine, New York; and additional tankage at Auburn, New York.

With these new additions, capacity will be increased 33 percent from Linden, New Jersey, to Macungie, Pennsylvania, and approximately 30 percent from Macungie north, the company announces.

Pipeline To Tap Alberta Gasfield

A 50-mile, 6-in. pipeline from a $4,000,000 pilot plant, 42 miles north of Edson, Alberta, to a junction with Trans-Mountain pipeline, has begun as the first stage of a $59,500,000 gas recovery program in Alberta by Hudson's Bay Oil & Gas, Canadian Fina, and Pan American Oil Company.

The pilot plant, also under construction, and the pipeline are expected to be completed in July. The projects are part of a huge program that would tap the gas reservoir in the Whitecourt area, 100 miles northwest of Edmonton, where proven, probable and possible gas reserves are estimated at 1.6 trillion cu ft.

Present capacity of the plant is designed to handle 30,000,000 cu ft of gas daily, but there is provision to expand facilities to 150,000,000 cu ft daily. Main products will be liquid hydrocarbons, butanes, and propanes estimated at 2500 bbl per day. The remaining sour gas will be injected back into the reservoir to maintain pressure.

Arabs Hear Proposal Of 1250-Mile Line

Saudi Arabia has submitted a plan to the Arab states for an Arab-owned, 1250-mile, 40-in. pipeline from the Persian Gulf to the Mediterranean. Called the "Tariki project" after Saudi Arabia's director of petroleum affairs, Abdullah Tariki, the plan was proposed in a study entitled "Middle East Pipe Lines and Their Economic Future" presented at the recent Arab petroleum conference.

The Saudi memorandum said the present oil company-owned pipelines connecting the Persian Gulf to the Mediterranean are not keeping pace with the increase of crude production.

The proposed pipeline would have a total capacity of at least 800,000 bbl daily and would cross Iran, Iraq, Kuwait, Saudi Arabia, Syria, and Lebanon, parallel to the Tapline pipeline. The paper gave no estimate of the cost of such a project. The paper said even if the governments do not participate, Arab private capital will finance the pipeline.

Iraqi-IPC Pipeline Eyed

The Iraqi government has reportedly requested the internationally-owned Iraq Petroleum Company to undertake the construction of a pipeline to run from Kirkuk in the north to the Persian Gulf, with Iraq footing the bill.

Company officers in London refused to comment on the reports or to furnish details of the company chairman's current visit to Iraq, a press association reports, but oil experts in London acknowledge the pipeline would have political advantages for Kassem's government by ending Iraq's dependence on pipelines that run to the Mediterranean through Syria, part of the United Arab Republic.

Competing Firms Ask to Build Gathering System

Two competing applications have been filed with the British Columbia Government for permission to build a crude oil gathering system to serve the Milligan Lake field. Peace River Oil Pipe Line Company, Ltd., which now operates the Sturgeon Lake line in north central Alberta, has asked for a route for a 200-mile 8-in. line to join its present line near Valleyview, Alberta. Gibson Crude Oil Purchasing Company, Ltd., has filed for a shorter line terminating at Dawson Creek, British Columbia, where a small refinery is situated.

Saskatchewan Power Names Contractors

Contractors have been announced for the construction of main natural gas transmission lines to be built under the Saskatchewan Power Corporation's 1959 program (*Pipeline Engineer*, May 1959).

Marine Pipeline and Dredging Ltd. was awarded the contract to build the 113-mile, 8-in., Regina-Yorkton line and the approximately 72 miles of 6 and 4-in. St. Louis-Tisdale line.

Dutton-Williams Brothers Ltd. received the contract for constructing the approximately 80-mile, 10¾-in., Success-to-Rosetown line.

Quoted from Mr. Dillard Stokes' Column, Shreveport Journal, Oct. 13, 1958.
"President Washington, who spoke of usurpation, said in his Farewell Address: 'If in the opinion of the people, the distribution of the Constitutional powers be in any particular wrong, let it be corrected by an amendment . . . but let there be no change by usurpation; for . . . this is the customary weapon by which free governments are destroyed'."
Specify
PELCO
Welding Saddles
PELICAN SUPPLY CO. INC.
P. O. Drawer 1108 Shreveport (84), La.
SEE YOUR NEAREST SUPPLY HOUSE
(Formerly: Pelican Well Tool & Supply Company)

WITH THE PIPELINE CONTRACTORS

● **Associated Pipe Line Contractors, 3115 Buffalo Drive, Houston Texas.** Has been awarded contracts by *The Rotterdam-Rhine Pipeline* to build 59 miles of 30-in. and 96 miles of 24-in. crude line from Rotterdam to Godorf and Wesseling, Germany, and a 25-mile smaller line to a Gelsenkuchen refinery.

● **B & M Construction Corporation, 2808 First National Bank Building, Oklahoma City, Oklahoma.** Has been awarded a contract to build 218 miles of 8-in. line for *National Iranian Oil Company* from Tehran to Resnt, Iran.

● **Bechtel Corporation, 220 Bush Street, San Francisco 4, California.** Has been awarded a contract by *Midwestern Gas Transmission Company* to double joint 210 miles of 30-in. in Illinois and Indiana. Headquarters is Wilmington, Illinois, with H. F. Mogg as superintendent.

● **Brown & Root, Inc., 4100 Clinton Drive, Houston, Texas.** Has contract with *Texas Eastern Transmission Corporation* to furnish field supervision for construction of 626 miles of 30-in. loops along the company's line between Beaumont, Texas, and Uniontown, Pennsylvania.

● **O. R. Burden Construction Corporation, P. O. Box 5216, Tulsa, Oklahoma.** Has been awarded a contract by *Northern Oklahoma Gas Company* to install 70 miles of 10 and 12-in. line between Cherokee and Ponca City, Oklahoma; and has been awarded a contract to construct 62 miles of 8-in. petroleum products pipeline connecting the *Texas Eastern Transmission Corporation* refinery at Tyler to the Little Big Inch pipeline system at Carthage. Has contract also to construct 93 miles of 8 to 20-in. gathering system from Falfurrias to McAllen, Texas, for *South Texas Natural Gas Gathering Company*. R. M. Jones is spreadman, with field office at Falfurrias.

● **Coates Field Service, Inc., P. O. Box 1581, Oklahoma City, Oklahoma.** Has contract for right-of-way acquisition for the *Peoples Natural Gas Company* on their 30-mile gas line located between Gibson and Imperial, Pennsylvania.

● **Dutton-Williams Brothers, Ltd., North Canadian Oil Building, Calgary, Alberta, Canada.** Has been awarded a contract by *Saskatchewan Power Corporation* to construct 80 miles of 10-in. from Success to Rosetown.

● **Fulghum Contracting Corporation, P. O. Box 1181, Harrisburg, Pennsylvania.** Has been awarded a contract to lay 100 miles of 12-in. pipeline from Watertown to Massena, New York, for *Niagara Mohawk Power Corporation*.

● **Fulton Banister, Ltd., 625 Northern Hardware Bldg., Edmonton, Alberta.** Has contract to lay 47 miles of 6-in. from Edson, Alberta, to Windfall field, 35 miles west of Whitecourt, for *Hudson's Bay Oil and Gas Company Ltd.* Field offices are at Whitecourt and Edson, with George Caron as superintendent.

● **R. H. Fulten & Company, P. O. Box 1526, Lubbock, Texas.** Has been awarded a contract by *Michigan Wisconsin Pipe Line Company* to build 211.7 miles of 24-in. pipeline in Kansas, Nebraska, and Missouri. Also has contract from *Northern Natural Gas Company* to lay 11 1/10 miles of 30-in. pipeline north of Sunray, Texas, and 8 1/10 miles of 30-in. north of Beaver, Oklahoma, with A. A. Carrigan as job superintendent in the field office at Beaver.

● **H. L. Gentry Construction Company, 921 East Michigan, Jackson, Michigan.** Has been awarded a contract by *Peoples Natural Gas Company* to lay 22 miles of 24-in. from Waynesburg, Pennsylvania, where the field office is located, to the West Virginia state line. Frank Morris has been named spreadman.

● **Houston Contracting Company, 2807 Buffalo Speedway, Houston 6, Texas.** Has contract to lay approximately 117 miles of 30-in. natural gas pipeline for *Texas Gas Transmission Corporation* in central and north Louisiana, with initial headquarters at Pineville, Louisiana, and R. L. Silar as superintendent. Also awarded contract to construct 41 miles of 30-in. natural gas pipeline for *United Gas Pipe Line Company* in the vicinity of Gulfport, Mississippi, where the initial headquarters will be, and Mobile, Alabama. M. L. Thompson has been named superintendent.

● **International Marine Constructors, C. A., Caracas, Venezuela. (Collins Construction Company, P. O. Box 86, Port Lavaca, Texas.)** Has been awarded a contract by the Iranian Oil Company to lay 25 miles of 30-in. at Ganaweh, on the Iranian shore, to Kharg Island, approximately 25 miles out in the Persian Gulf.

● **Latex Construction Company, Box 12128, Atlanta 5, Georgia.** Has been awarded the following contracts: *Arkansas Fuel Oil Corporation*, the enlargement of a marine terminal at Port Everglades, Florida, R. D. Copeland in charge; *Everglades Pipe Line Company*, 35 miles of 10-in. from Ft. Lauderdale to Miami, Florida, with O. P. Hiner in charge, and construction of a pumping station in Port Everglades, with D. C. Rinehart in charge; and *Plantation Pipe Line Company*, reconditioning 90 miles of 4, 10 and 12-in. in Georgia, Mississippi, and South Carolina, G. H. Matlock in charge.

● **Macco Corporation, 14409 South Paramount Boulevard, Paramount, California.** Has prime contracts with various companies to construct pipelines in various sizes through 30-in. in California.

● **Majestic Contractors, Ltd., 408 Royal Trust Building, Edmonton, Alberta, Canada.** Has an undetermined amount of gas gathering system for *Producers Pipeline Company* in the Estevan, Saskatchewan, area.

● **Mannix Company Ltd., 737 8th Avenue, S.W., Calgary, Alberta, Canada.** Has been awarded a contract to construct 122 miles of 30-in. for *The Alberta Gas Trunk Line Company Ltd.* from Princess to Torrington, Alberta, with field office located in Brooks and V. J. Worcester as superintendent. Also has received a contract from *Pembina Pipe Line Ltd.* to lay 40 miles of 3 to 6-in. from the Pembina field. Field office for the latter is located in Drayton Valley, Alberta, and superintendent is S. Steffen.

● **Marine Pipeline & Dredging Ltd., 640 West Hastings Street, Vancouver 2, B. C., Canada.** Has been awarded a contract by *Saskatchewan Power Corporation* to construct 113 miles of 8-in. from Regina to Yorkton and 72 miles of 4 and 6-in. from St. Louis to Tisdale.

● **J. Ray McDermott & Company, Inc., P. O. Box 38, Harvey, Louisiana.** Has been awarded a contract by *Venezuelan Sun* for an 18-in. crude pipeline from Block 1 in Lake Maracaibo to a terminal at Punta Palmas.

● **Panama, Inc., 2201 Commerce Building, Houston 2, Texas.** Has been awarded a contract by *Humble Oil & Refining Company* to construct 238 miles of 30-in. natural gas pipeline from the King Ranch in Texas to the Clear Lake gas plant in Houston, Texas.

● **Panama-Williams Corporation, 1418 Melrose Bldg., Houston, Texas.** Has been awarded a contract to lay approximately 125 miles of 24-in. pipeline in the vicinities of Centerville and Mt. Pleasant, Iowa, and Kewanee, Illinois, for *Michigan Wisconsin Pipeline Company*.

● **Pentzien, Inc., 1504 Dodge Street, Omaha, Nebraska.** Has been award a contract by *Michigan Wisconsin Pipe Line Company* to install a single 24-in. submarine crossing of the Missouri River. Spreadman is James R. Zeman, and field office is located at Rulo, Nebraska.

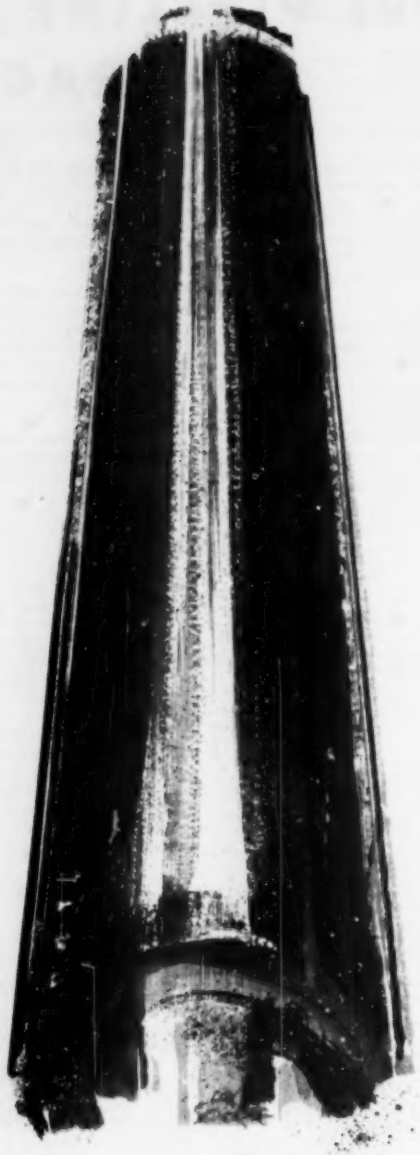
● **Alex Robertson Company, 14433 Paramount Blvd., Paramount, California.** Has been awarded a contract to construct 60 miles of 20-in. from Cuyama to Ventura, California, for *Richfield Oil Corporation*, with field office in Ventura under the supervision of R. E. White and K. Pratt.

CONSTRUCTION FEATURE

● **Rosson-Richards Processing Company, P. O. Box 908, Corpus Christi, Texas.** Has been awarded a contract by *Tennessee Gas Transmission Company* to clean and paint 200 miles of 30-in. in Wisconsin, with headquarters at Oak Creek under Elton Hood, superintendent.

● **Sharman, Allen, Gay & Taylor, Inc., 3115 Buffalo Drive, Houston, Texas.** Has been awarded contract by *Freeport Sulphur Company* to lay approximately 33,000 ft of pipeline in south Louisiana. Field office for the latter job is Grand Isle, Louisiana, and spreadman is Chester Lake.

● **Somerville Construction Company, 6648 Fulton Road, Ada, Michigan.** Has been awarded a contract by *Michigan Wisconsin Pipe Line Company* to construct 38.2 miles of 24-in. pipeline in Michigan. Harold Cook is superintendent and field office is located at Allegan, Michigan.



Pipelines!

Hallmac is financially capable of performing

on any size project– meeting your delivery dates, making

important savings for you! When you talk pipelines, talk to

J. W. (Bill) Hall, President, Hallmac Construction Company,

3701 Buffalo Drive, Houston.

Contractors

● **H. C. Price Company, Price Tower, Bartlesville, Oklahoma.** The pipe coating division has the following jobs in progress. At Harvey, Louisiana: For *United Gas Pipe Line Company*, 75 miles of 6 to 30-in., somastic coating, and 71 miles of 6 to 30-in., hevicote concrete coating; *Transcontinental Gas Pipe Line Corporation*, 25 miles of 20-in., somastic and hevicote coatings, 5 miles of 8-in., somastic coating, and internal coating to 1 mile of 20-in.; *Hunt Oil Company*, 2 miles of 6-in., somastic coating. At Vanderbilt, Texas, railhead plant: *Humble Oil & Refining Company*, 6 miles of 30-in., hevicote coating; and *Coastal Transmission Corporation*, 7 miles of 20-in., hevicote coating. At West Point, Kentucky, railhead plant: *Tennessee Gas Transmission Company*, 140 miles of 30-in., internal epoxy paint. At Philadelphia, Pennsylvania: *Atlantic Refining Company*, 6 miles of 30-in., somastic coating, and 3900 ft of 30-in., hevicote coating; *Brooklyn Union Gas Company*, hevicote to 2 miles of 24-in.; *Commonwealth Edison Company*, somastic and interior coating to 8 miles of 5-in.; *Consolidated Edison Company*, enamel coating to 1 mile of 30-in.; *Florida Power Corporation*, somastic and interior coatings to 4 miles of 6-in.; *Samuel Gallucci & Sons, Inc.*, hevicote coating to 2 miles of 24-in.; *General Cable Corporation*, somastic coating to 3397 ft of 6-in. and interior coating to 1 mile of 6-in.; *The Okonite Company*, somastic and interior coatings to 4 miles of 5-in.; *Phelps Dodge Corporation*, somastic coating to 14 miles of 6 to 8-in. and interior coating to 20 miles of 6 to 8-in.; *Philadelphia Gas Works*, 32 miles of 3 to 20-in., somastic coating; *Philadelphia Electric Company*, 28 miles of 6 to 20 in., somastic coating; *Public Service Electric & Gas Company*, somastic coating to 2 miles of 4 to 8-in. and interior coating to 3 miles of 4 to 8-in.; and *Transcontinental Gas Pipe Line Corporation*, somastic coating to 48 miles of 36-in.

● **Western Pipe Line, Inc., P. O. Box 1076, Austin, Texas.** Has been awarded a contract by *Texas Gas Transmission Corporation* to lay 8.72 miles and 10.03 miles of 26-in. loops in Kentucky, where field office will be located at Cloverport, under John R. Wells, spreadman; and to lay 9.49 miles and 9.23 miles of 30-in. loops in Mississippi, where field office will be located at Shaw under Aldress Kilgore, spreadman.

● **Williams Brothers Company, National Bank of Tulsa Bldg., Tulsa, Oklahoma.** Has received a contract from *Consumers Power Company* to construct 40 miles of 24-in. pipeline from Woodbury to Laingsburg Junction, Michigan. Has been awarded a contract by *United Gas Pipe Line Company* to lay 49 miles of 30-in. from Lirette, Louisiana, to Lake Pontchartrain, with field office at Raceland, under O. R. Mitchell, superintendent; also a contract to lay 20 miles of 20-in. for *Louisville Gas and Electric Company* from Muldraugh to Louisville, Kentucky, where field office is located, with Earl Saulsman as spreadman; 15 miles of 20-in. in Iowa, 3 miles of 20-in. in Illinois, and 6660 ft of 24-in. across the Mississippi River for *Northern Natural Gas Company*, with field office at Dubuque, Iowa; and 45 miles of 20-in. from Mt. Seneca to Terra Alta, West Virginia, for *Atlantic Seaboard Corporation*, under Thelmer Davis, superintendent.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

PIPELINE PERSONALS

Willis A. Strauss has been elected executive vice president of Northern Natural Gas Company. **John Merriam** is president, and senior vice presidents constituting the policy committee are: **A. B. Dilworth; W. L. Shomaker; M. L. Mead; and P. A. Gass.**

W. A. Strauss

R. N. Curry

Robert N. Curry has been appointed assistant superintendent of gas measurement for Texas Gas Transmission Corporation, according to an annonuncement by **C. W. Brown,** superintendent of the department. Curry will assist Brown in the overall direction of the gas measurement function throughout the nine states in which Texas Gas operates its pipeline system.

Grey Linsley and **G. A. Welsh** have been elected vice presidents of Great Lakes Pipe Line Company. Linsley is manager of the finance division, and Welsh is manager of the traffic division. **L. B. Seck,** formerly secretary and tax attorney, has been appointed general counsel in addition to his office as secretary of the company.

W. W. Cofield has been named to the newly-created position of assistant superintendent of the measurement department of Transcontinental Gas Pipe Line Corporation. Cofield previously held the position of senior engineer in the pipeline department for Transco.

J. A. Hatfield has been promoted to general superintendent of Plantation Pipe Line Company and will be responsible for the operation of the pipeline system which extends from Louisiana to North Carolina. Since joining the company in 1942, Hatfield has been manager of various electric pump stations, division superintendent of the company's eastern division and western division, and, prior to his promotion, assistant general superintendent in the main office of the company in Atlanta.

John H. Williams, Charles P. Williams, David R. Williams, Wilbur J. Holleman, and **Robert E. Palmer** have been re-elected directors of Williams Brothers Company.

Norman F. Tietze has been appointed general superintendent of products pipelines in the supply and transportation-operations department of Standard Oil Company (Indiana), succeeding **Oscar A. Abbey** who is retiring after 38 years of service. Named to replace Tietze as division manager, Twin Cities pipeline division, is **H. W. Wilker;** and **C. G. Weibel** will succeed Wilker as division superintendent, pipelines; and **H. I. Johnson** will replace Weibel as division engineer.

Russell R. Bryan, formerly right-of-way buyer at San Antonio, Texas, for United Gas Pipe Line Company, has been transferred into the company's general office right-of-way department at Shreveport, Louisiana, as right-of-way supervisor. Other personnel changes announced by United Gas Pipe Line Company include: **George Kennedy,** previously communications and corrosion technician, named right-of-way buyer at Beaumont, Texas; **Hugh L. Ralley,** promoted to senior welder at Carthage, Texas; **W. J. Cole,** formerly maintenance crew foreman at Carthage, promoted to section foreman at Edna, Texas; **Floyd T. Garner,** named right-of-way buyer for the general office right-of-way department; and **Calvin O. Southall,** assigned as pipeline section foreman at Petal, Mississippi.

G. P. Jennings has been elected president of The Pipe Liners Club of Tulsa, and **Walter E. Biery** has been elected vice president. Other officers elected are: **G. V. Rohleder,** secretary; and **J. R. Ellis,** treasurer. Two directors elected are **H. T. Chilton** and **Oscar R. Burden,** who will serve with **R. L. Briggs** and **H. D. Chrislip.**

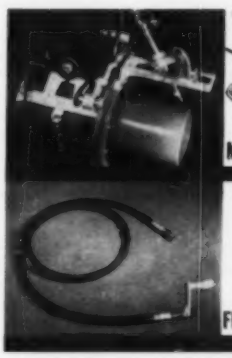
Maurice P. Paulson, formerly operations manager and chief engineer for Home Oil Company, Ltd., has been named general manager of production and pipelines succeeding **R. W. Campbell** who has been promoted to general manager of the company. **J. H. Hamilton,** formerly assistant operations manager, has been named assistant to the general manager.

A. E. Lain, supervisor of the operations and engineering section in Shell Pipe Line Corporation's Tulsa office, has been transferred to New Orleans as district superintendent.

In recent promotions involving Natural Gas Pipeline Company and Texas Illinois Natural Gas Pipeline Company compressor station personnel, **D. R. Wendele** has been named superintendent at Stinnett, Texas; **R. L. Pivonka,** assistant superintendent at Fritch, Texas; and **R. G. Shaddox,** station superintendent at Wharton, Texas.

John Hanley, vice president, and **R. Dean Grimm,** manager of gas supply, Northern Natural Gas Company, have announced the following changes in the company's gas supply department: **Rex D. Fowler** has been promoted to assistant manager of gas supply; **G. L. Tribble** to manager of gas purchased operations; **M. A. Wilson, Jr.,** to manager of gas purchases; and **W. E. Ainsworth** to coordinator of gas supply. Ainsworth will be transferred temporarily to Calgary, Alberta, Canada, to open a gas supply office to investigate prospective natural gas supplies in that area.

Charles R. Williamson has been appointed superintendent of Northern Pipe Line Company and New York Transit Company, Inc., wholly-owned subsidiaries of The Buckeye Pipe Line Company. Prior to this assignment, Williamson was assistant superintendent, gathering lines, at Lima, Ohio. Williamson also has been elected a director of New York Transit Company, Inc.



designed for profit . . .

H & M Accessories mean faster, easier pipe cutting & beveling

MOTORIZED UNIT provides fully automatic operation for H&M pipe cutting and beveling machines. Motors are built for consistent, smooth operation . . . steady power.

FLEXIBLE SHAFT . . . allows one man complete visibility when cutting pipe. Regulates speed of torch at all times. Attaches easily to any H&M Machine.

PIPE DOLLIES . . . for leveling, aligning and rolling pipe. Designed for safety, speed and accuracy in pipe fabrication. Reduces pipe handling time up to 85%.

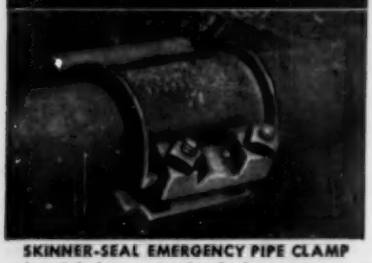
BOXES . . . . . . specially designed to safeguard H&M Pipe Cutting and Beveling Machines. Special fitting holds the assembly firmly in place. Available for all sizes of H&M Machines.

HOOKS & CLAMPS

WRITE FOR ILLUSTRATED CATALOG SHEETS ON THE H&M ACCESSORY LINE.

H&M PIPE BEVELING MACHINE COMPANY
311 E. Third St. DI 3-0241
TM Reg TULSA, OKLAHOMA

PIPE LEAK REPAIR
— QUICK, FINAL!
ANY PRESSURE — ANY TEMPERATURE



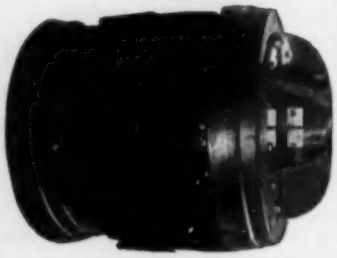
SKINNER-SEAL EMERGENCY PIPE CLAMP for pinhole or corrosion leaks.

SKINNER-SEAL PIPE LINE CLAMP for long splits and bad corrosion leaks.

In stock — all supply stores

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

MOLE
Pipeline
Cleaner



for BETTER cleaning of
CRUDE LINES
PRODUCT LINES
NATURAL GAS LINES

FOR DETAILS WRITE

Pipeline Cleaners Co.
Fort Madison, Iowa

It's New | Pipeline Equipment

Packaged Panels For Compressor Control

A new line of packaged control systems, designed for any degree of compressor automation, has been introduced. Consisting of three basic control panels, the "packaged automation" ranges from a simple engine start system to a fully automatic engine and compressor control for remote location. With the addition of a computer controller and telemetering equipment, any number of remote automatic panels can be tied together for the automation of a complete station or pipeline. *Clark Bros. Company.*

Circle number (81) on reply card.

Automatic Gage For Low-Pressure Tanks

A new ground reading automatic tank gage has been announced as an economy planned package unit for the convenience of those who have 16-ft small bolted low-pressure tanks in service and want to add an automatic tank gage and/or any of the various gage operated accessories. It is available with either guided or unguided float. No welding is required during installation; all the fittings are bolted to the tank. The bottom guide wire anchor and the float may be installed through an existing hole (gage hatch). *The Vapor Recovery Systems Company.*

Circle number (82) on reply card.

Electronic Equipment And Pottermeters

New electronic readout and control equipment is now available to incorporate turbine-type Pottermeters into any remote control, remote reading or telemetering system for the handling of petroleums. Pottermeter's turbine-rotor generates an electrical current of intensity directly proportional to the flow rate, and the current is transmitted to any type of electronic equipment required. Capacities from 0.1 gal per min to 40,000 gal per min or more, with unlimited operating pressure, and temperature range from — 455 F to + 1500 F, provide broad application possibilities. *Pottermeter-Bowser Division, Bowser, Inc.*

Circle number (83) on reply card.

New Pistol Grip Electrode Holder

A new holder for arc welder electrodes resembles a large calibre automatic pistol. The Handi-Arc has a molded pistol grip—the instant the grip is released, current is off. Its tip grip on electrodes permits use of electrodes down to a short

stub. It has a pushbutton stub ejector, adjustable copper jaws to accommodate rods of different diameters, is in a red plastic case, and has a receptacle in the handle for self clamping attachment of lead cord. *Frank Niemi Metal Products, Inc.*

Circle number (84) on reply card.

Explosion-Proof Pressure Control

A waterproof, explosion-proof, calibrated control has been developed for air, gas or liquid pressures in hazardous locations where explosive gases or vapor are present. Pressure ranges of this new control extend from 10 psi to 1700 psi, with a proof pressure of 2500 psi and a maximum pressure of 3500 psi. The Type H98 maintains settings without drift and may be mounted in any position without recalibration, the manufacturer states. Pressure settings are made by turning a knurled knob against a calibrated dial. The settings may then be locked with an allen wrench to avoid unauthorized tampering. A tamper proof screw-on cap is also provided for additional protection. A variety of switches are single pole and suitable for ambient temperatures up to 180 F. *United Electric Controls Company.*

Circle number (85) on reply card.

X-Rays 40 Ft Per Minute

Circle number (86) on reply card.

A new machine that can radiograph every inch of every weld, both longitudinal and circumferential, in a 40-ft length of pipe in less than one minute has been announced. Travel-Ray, projecting a narrow beam of parallel rays, eliminating "scatter" radiation, can X-ray up to 2000 ft of pipe in one continuous operation and obtains sensitivities of 1 to 1.5 percent. Adjustable for pipe diameters from 12 through 36 in., featuring special 6 and 12 wheel drive crawlers, and offering variable band width, speed, and power up to 250 kv, Travel-Ray can be used at the mill, in the field, at river-crossing sites, and elsewhere. *Travel-Ray Corporation.*

Facsimile Unit Works On Wire Or Microwave

Paper work, records, documents, orders, etc., can now be sent by a new electronic facsimile unit over either leased wires or by microwave as easily as making a telephone call. With the Electronic

Messenger, communications — whether printed, typed, written or drawn — can be transmitted and reproduced to other stations in the system. An electric eye scans the material and sends electrical impulses over telephone line, direct wire or microwave to duplicate the original message on one or more companion machines anywhere . . . in the same building or hundreds of miles away. When not sending, the machine is ready at all times to receive communications. *Electronic Communications, Inc., Facsimile Equipment Div.*

Circle number (87) on reply card.

New Pipelayer Has 17,500-Lb Lift

This FWD Blue Ox wheeled tractor mounts a sideboom pipelayer capable of lifting 17,500 lb at 4-ft radius. The hydraulically-operated front-mounted blade is used for backfilling. The manufacturer states that it features speed, maneuverability and four-wheel-drive traction. *FWD Corporation.*

Circle number (88) on reply card.

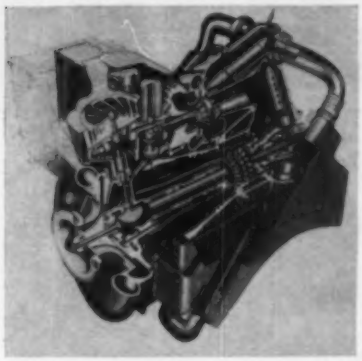
Plastic Pipe Fittings

New 90-deg and 45-deg elbows, tees, couplings, and other fittings have been announced for either thread-end or plain-end Bondstrand reinforced plastic pipe. Fittings for the latter are connected by a patented locking wedge feature. Ductile iron flanges with the locking wedge feature are designed so the piped contents cannot contact the iron. A second type of flange is now being perfected entirely of the Bondstrand material, and flanged and Victaulic-type fittings made of glass fiber and epoxy are soon to be released and are expected to prove especially useful where make-and-break connections are desired. *Amercoat Corporation.*

Circle number (89) on reply card.

Light Gas Turbine Has 2-Stage Air Compression

This is a cutaway view of Ford Motor Company's new 300-hp gas turbine engine. It weighs 650 lb (one-fourth that of a truck diesel engine of comparable horsepower), has two stages of air compression enabling the engine to deliver more horsepower from a smaller size.



It is approximately 38 in. long, 29 in. wide, and 28 in. high, has dual burners, attains maximum fuel economy in a range of 25 to 100 percent of power, can use a wide variety of light diesel fuel, and requires no warm-up period. Each compressor stage effects a 4-to-1 air compression. Ford expects to be testing the new engines in vehicles before the end of the year and states that possible applications besides cars and trucks might include heavy duty tractors, bulldozers, earth movers, and off-road vehicles of any type. *Ford Motor Company.*

Circle number (90) on reply card.

Dispersion Coating Of Polyethylene

A sprayable high-density polyethylene coating, based on Super Dylan, has been introduced for application to metals and glass. The new coating is said to demonstrate freedom from pinholes. Application studies have included the evaluation of these liquid dispersions as lining for pipelines and as tank coatings in highly corrosive solvent systems. *Koppers Company, Inc.*

Circle number (91) on reply card.

New Portable Welder For Aluminum Pipe

A 40 to 50-lb, easily portable, automatic circumferential welding machine has been developed for butt welding aluminum pipe. With this equipment, a 4½-in. diam standard pipe can be butt-welded in less than 1 minute, without any "programming." To make a joint, the unit is held in position by a strap clamp and the welding gun and cable drum gear travel around the horizontal axis of the pipe. *Aluminium Limited.*

Circle number (92) on reply card.

Write for Bulletin

PATENTED

NAME OR EMBLEM

PIPE GAS LINE

PIPELINE VENTS AND MARKERS

FLEET-LINE CO.

P. O. BOX 276-A
SHREVEPORT
LOUISIANA

Write for Specifications Folder

FLEET-LINE

WELDING FITTINGS

REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.

SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

Complete encirclement saddles.

Fast interested service. Write for Literature.

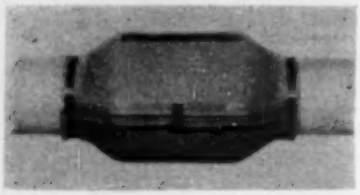
STEEL FORGINGS, Inc.

P. O. Box 276 A • Shreveport, La.

New Equipment

For Field Coating Of Pipe Couplings

The new Kupl-Koter, for field coating of pipe couplings, consists of two halves, each having a sponge rubber gasket firmly cemented in a groove in the leading edge.



The two halves are brought together around the coupling, with the filling slot in proper position at the top, and clamped together with slip-on side clamps. Steel bands are placed around each end and drawn up tightly by means of a standard hand banding tool. The Kupl-Koter will handle all coatings at recommended pouring temperatures, is said to support the coating without tamping or special backfilling, will accommodate electrically bonded couplings, and can be left on the pipe after coating is poured. In sizes from 3 to 12-in. ID, *Dresser Manufacturing Division.*

Circle number (93) on reply card.

Shovel-Crane Unveiled

A new ¾-yd (12½ to 30-ton capacity) shovel-crane has been introduced with Speed-O-Matic power hydraulic controls, interchangeable, self-adjusting clutches, and a "split control panel" for clear view excavating visibility. On the LS-78, there are separate sets of shafts, gears, and clutches that provide a separate power flow for each machine function. Other features include: Power hydraulic steering; spring-applied digging brakes; adjustable hook rollers mounted on anti-friction bearings; large diameter shafts mounted on anti-friction bearings; and involute-splined, heat-treated shafting throughout. *Link-Belt Speeder Corporation.*

Circle number (94) on reply card.

Improved Worm Gear Speed Reducers

A broad new line of heavy duty worm gear speed reducers is announced. Featured are all ratios from 5-1/6: 1 to 1212; 1 with center distances from 3 to 21-in. and any horizontal or vertical drive arrangement. Standardized mounting bases, worm gearing, single and double helical attachments, fans and torque control attachments permit top, bottom or side mounting with or without mounting base. Drive arrangements include horizontal — top or bottom, and vertical — shaft up or down. *Philadelphia Gear Corporation.*

Circle number (95) on reply card.

NEW PIPELINE LITERATURE

More About Channels In Microwave Bulletins

A new series of microwave bulletins, featuring channel facilities in 2 kmc systems, has been issued. Described are: terminal stations, multiplex repeaters and junctions which serve as the "doors" through which information comes into and departs from the microwave carrier. An application table shows how services such as teletype, telemetry, supervisory control, and telegraph are applied to the carrier. *General Electric.*

Circle number (96) on reply card.

"4-in-1" Skid-Shovel

On-the-job photographs in a new 16-page, two-color catalog detail the Drott TD-15 "4-in-1" skid-shovel on which the bucket provides four prime construction units in one tractor loader. Moving a "machine selector" lever gives the operator a choice of bulldozer, scraper, clamshell, or skid-shovel actions. *International Harvester Company.*

Circle number (97) on reply card.

Traxcavator Details

Design improvements, increased power, performance and work capacity of the new Caterpillar No. 933 Series F Traxcavator are detailed in a new 6-page, 2-color pamphlet. *Caterpillar Tractor Co.*

Circle number (98) on reply card.

Slide Rule Calculates Tank Capacity, Size

Pipeliners will want this handy, pocket-size slide rule calculator (it's free) for determining capacity and size of storage tanks up to 100 ft high and 300 ft in diam. Capacities are given in gallons, barrels, and pounds of water. The calculator also gives: Decimal equivalents of a foot for all inch units and fractions; equivalent volumetric units, and steel plate weights for thicknesses from 3/16 in. to 1 in. *Hammond Iron Works.*

Circle number (99) on reply card.

Engines, Power Units

Design, engineering, and performance capabilities of Allis-Chalmers' G-226 and G-149 engines and power units are told in two new catalogs. Both catalogs are illustrated, and optional equipment is listed. *Allis-Chalmers Manufacturing Company.*

Circle number (100) on reply card.

System Summates Multiple Meter Flows

The Proportioneers meter accounting system for summating multiple meter flows along the pipeline is described in a new application bulletin. Console units, built in three panel styles and usable with any make of positive displacement meters, show individual meter flow and total meter flow, automatically integrating flows and compensating the readings for meter factor and for temperature variations along the pipeline. Accuracy of readings is described as ±.02 percent. The 4-page bulletin contains photographs of the three styles of meter panels, a typical arrangement drawing of the units, several installation photographs and descriptive text on the Proportioneers method of meter accounting using "building block" construction. *B-I-F Industries, Inc.*

Circle number (101) on reply card.

Aluminum Pipe Couplers

Threadless couplers for aluminum pipelines are featured in a new product bulletin. Photographs point up the simplicity of design, positive sealing of gasket, and the locking and unlocking with a ¼ turn of spanner wrench. Couplers are for O.D. or I.P.S. pipe, up to 4-in. size and 1000 psi working pressure. *John Bean Division, Food Machinery and Chemical Corporation.*

Circle number (102) on reply card.

THROUGHOUT THE WESTERN HEMISPHERE

All or Any Part of These Services Are Available to Our Clients

Consulting Planning & Design
Route Studies & Selection
Aerial Photography
Photogrammetric Survey & Mapping
Ground Survey
Construction Supervision

LOCKWOOD-KESSLER & BARTLETT, INC.
One Aerial Way
SYOSSET, L. I., N. Y.

COATES Field Service, INC.
P. O. BOX 1281 OKLA. CITY

Land Evaluation Studies
Title Search
Survey Permits
R/W & Land Negotiation
Easement & Permit Acquisition
Damage Claims Settlement
Establishment of Land-Owner Good Will

ENGINEERING and LAND SERVICES

ANOTHER EDITORIAL SERVICE FEATURE OF
THE PETROLEUM ENGINEER PUBLISHING COMPANY

The First Comprehensive . . .

World-Wide Directory

of Petroleum Supply and Service Organizations

From Algeria to Yugoslavia, listings include:

- ***Company name and address***
- ***What's available***
- ***Manager's name***
- ***Firms represented***
- ***Cable code***
- ***Telephone number***

Published as a Supplement to All Editions of The Petroleum Engineer Publishing Company, 800 Davis Bldg., Dallas, Texas

World-Wide Directory

Petroleum Industry Supply and Service Companies

Equipment and technical service for oil and gas operations have followed the industry into almost every country in the world . . . More and more materials are bought on the spot . . . In many out-of-the-way places you can call a service company as you do in more developed areas . . . Here are listed the companies, their locations, and managers.

- Companies are listed under countries but are not alphabetical.
- Items available are listed briefly and are not in detail.
- Manufacturing firms represented by supply companies are listed under names of the latter.
- Cable code is in LIGHTFACE CAPS.

ALGERIA

CONTINENTAL EMSCO
Drilling and producing equipment.
Algiers: 8 rue Poiret. UNAFRIC. Rolf Zaugg, rep.

ETS. G. MUSSO
Distributor, LeTourneau-Westinghouse Co. Construction machinery.
Algiers: 126 bis, Rue Michelet. OSSUM.

EXPLOR. GEOPHYSIQUE ROGERS
Geophysical contractor.
Algiers: 17 rue Edgar Quinet. Tel. 589-49, 564-92, 581-13. ROGEXCO H. W. Beauchamp, mgr.

HAMELLE-AFRIQUE
Distributor, D. W. Onan & Sons. Electric plants, generators, air-cooled engines.
Algiers: 27 Blvd. Carnot.

INCO (INDUSTRIE ET CONFORT)
Distributor, Carrier Corp. Air conditioning, refrigeration and heating.
Algiers: 4 rue de Dr. Lucien Raynaud. INCO. Tel. 653-35.

LA COMPAGNIE CENTRAL INDUSTRIELLE ET COMMERCIALE
Distributor, Oil Well Supply. Oil field supplies.
Algiers: 2 rue du Docteur Trolard.

LE MATERIEL DE SONDAGE.
Distributor, Well Instrument Dev. Co. Electric well logging equipment.
Algiers: 38 Blvd. Saint Saens. Tel. 402-37. MATERSONDA. P. Lavaud, Mgr.

PETROCHIMIE-ALGERIE
Dist., T. D. Williamson (insulators, tapping machines, stopples, pigs, casing seals).
Algiers: 12 Ave. Pasteur. Tel. 351-93.

SOCIETE IMEX
Distributor, George E. Failing (drilling rigs); Bucyrus-Erie (drills, construction machinery).
Algiers: 32 rue Polignac.

UNION INDUSTRIELLE AFRICAINE
Distributor, Continental-Emsco. Drilling and producing equipment.
Algiers: 1 rue Joinville, Tel. 485-56. UNAFRIC. Andre Miller, pres.

NEYRPIC-AFRIQUE
Dist., Ideco-Dresser (drilling rigs, drilling and producing equipment).
Algiers: Box 523. Tel. 722-23. ALNEYRPIC.

ARGENTINA

F. B. ALLAIRE
Distributor, Cameron Iron Works. Blowout preventers, Xmas trees, valves, and instruments.
Buenos Aires: Pasteur No. 1034, Martinez. Tel. 792-2331. CAMIRON.
Buenos Aires: Avda. Pte. R. Saenz Pena 832. IDECOARG.

AMERICAN MARC, INC.
Diesel engines, generators, generating sets.
Buenos Aires: Chacabuco 443/49. Tel. 33-0035. C. E. Edwards, mgr.

ARMCO ARGENTINA S.A.
Dist., National Supply (oilfield supplies).
Buenos Aires: Corrientes 330. Tel. 31 (Retiro) 6215. ARMCO.

BOLLAND & CIA S.R.L.
Dist., Dresser Industries: Lane-Wells (oilfield services, perforating, well logging, packers); Security Inter'l. (drill bits); Southwestern Ind. Electronic (seismograph equipment), Ideco (drilling rigs, drilling & producing equipment).
U. S. Industries: Inter'l. Div. (oilfield tools & equipment); Axelson (pumps, rod liners).
American Iron & Machine (packers, overshots), Martin Decker (indicating, recording drilling control instruments); Webb Wilson (drill tools).
Buenos Aires: Avda. Pte. R. Saenz Pena 832. Egon Ostry, mgr.

JORGE J. BUTLER
Representative for Kerotest Manufacturing (cast steel valves, gate, globe, angle, check, pipe line, flow line, drilling, etc.) and Shand and Jurs (conservation and safety equipment for storage tanks, tankers, automatic level gaging, control equipment, systems engineering); Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction); Curtis-Wright (alloy steel pressure pipe).
Buenos Aires: Reconquista 558. Tel. 32-3068. JORGBUTLER.

BUXTON, LTDA, S.A.
Distributor, Hercules Motors. Hercules and Hall-Scott gasoline and diesel engines, Lycoming gasoline engines.
Buenos Aires: Casilla de Correo No. 1999, Posadas 1245. Norman H. Danby, pres.

CAIMSA
Dist., Orbit Valves.
Buenos Aires: Sarmiento 2444. Dr. Emilio F. Barone, mgr.

CIA. ARGENTINA IMPORTADORA DE MAQUINARIAS S.A.
Dist., Cabot Shops & Franks Div. (pumping units & drilling well servicing & workover equipment).
Buenos Aires: Sarmiento 2444. Tel. 48-7239-7230. CAIMSA. Emilio Francisco Barone, mgr.

CEBEL, S.A.
Dist., Gulf States Asphalt (pipe enamel).
Buenos Aires: Alsina 1680. Tel. 45-6030 and 37-1051. Ignacio Prayermauer, mgr.

COASIN, S.R.L.
Dist., Swartwout (automatic control components & systems).
Buenos Aires: Fiel 967/69. Roberto Maidanic, mgr.

CLARK BROS. PAN AMER. DIV.
Pan American Div.—Dresser Industries, (compressors, engines, gas turbines).
Buenos Aires: Viamonte 867.

CERAMICA OLIVOS S.A.
Distributor, Mexico Refractories. Refractory castables, mortars, ramming materials.
Buenos Aires: Sarmiento 470. Tel. 34, Defensa 6608. DEX. Bernardo Fainberg.

CARRIER-LIX KLETT, S.A.
Distributor, Carrier Corporation. Air-conditioning, refrigeration, and heating.
Buenos Aires: Florida 229. CARRI-KLETT. Tel. 33-8184-85-86.

COLTECH LTDA.
Dist., Petroleum Technologists. Core analysis lab.
Buenos Aires: Charcas 1775.

COMPANIA STANDARD ELECTRIC ARGENTINA S.A.I.C.
Distributor, D. W. Onan & Sons. Electric plants, generators, air-cooled engines.
Buenos Aires: Uruguay 1037.

CONSTRUCCIONES METALICAS ARGENTINAS
Distributor, Oil Well Supply. Oil field supplies.
Buenos Aires: Cordoba 320. Tel. 32-6041.

CORE LABORATORIES
Mud logging, core analysis, reservoir fluid analysis, reservoir engineering.
Buenos Aires: John Jorden, mgr.

BAZA S.R.L.
Dist., Wheaton Brass Wks. (valves and fittings).
Buenos Aires: Balbastro 646.

DOWELL DIV.-DOW QUIMICA ARG.
Acidizing, fracturing, cementing, chemical cleaning services for industrial equipment.
Buenos Aires: Avenida Belgrano 1670; G. T. Lamberson, mgr.
Commodoro Rivadavia, Chubut: Casilla Correo 114.

DRILLEX.
Distributor, Cameron Iron Works. Blowout preventers, Xmas trees, valves and instruments.
Buenos Aires: Salta 478. Tel. 37-6496. DRILLEX, Baires, G. Gomez, mgr.

DROGUERIA SAAVEDRA
Dist., Foxboro (recording flow meters, control instruments).
Buenos Aires: Ave. Presidente Roque, Sanez Pena 570. Tel. 33-1292 & 34-6149, 34-6220. DROSA. Hector Garcia, mgr.

EVEREADY S.A.
Dist., Union Carbide Inter'l., (chemicals, chemical & metallurgical carbon & graphite specialties, silicones, welding & cutting equipment).
Buenos Aires

FIORE CO.
Distributor, Marmon-Herrington Co. All wheel drive Fords.
Buenos Aires: Viamonte 1570. FIOCO. A. I. Grinberg, ass't. mgr.

GENERAL ELECTRIC ARG.
Dist., Bucyrus-Erie & Ruston-Bucy (drills, construction machinery).
Buenos Aires

GENERAL MOTORS ARGENTINE
Diesel engines, vehicles, spare parts.
Buenos Aires: Rio Limay 1725-33/8. Tel. 21-3601. BAIRAUTOEX.

HUDSON ENGINEERING CORP.
Design and construction of process plants.
Buenos Aires: Corrientes 1115.

J. VAZQUEZ IGLESIAS
Dist., Mack Trucks.
Buenos Aires: Hipolito Yrigoyen 2655/81. VAZIGLE.

KELLOGG PAN AMERICAN CORP.
Engineering & construction of refineries.
Buenos Aires: Cangallo 1333. Tel. 45-1801. BARRERA. Grl. bg. (R.A.) Raul Barrera, mgr.

KNIGHT OLIVELLA & CO.
Dist., Yarnall-Waring (blow-off valves, water gages, liquid level indicators, expansion joints, steam traps, strainers).
Buenos Aires

KREGLINGER, LTDA.
Dist., DuPont Co. (elastomers).
Buenos Aires: Casilla Correo 44.

LANGLEY & CIA.
Representative, Foster Cat (catheads and tension indicators) Wilson Mfg. Co. (rigs, winches, masts, pumps) Oil Metering and Processing (crude oil metering & testing equipment); Overstrom & Sons (mud screens and parts therefor); Mission Manufacturing (oilfield equipment); McCullough Tool (wire line and fishing tools); Barton Instrument (twin bellow flow meter); Daniel-Orifice (fittings, pressure bombs, gas heaters, manometers, flanges).
Buenos Aires: 1115 Corrientes. Tel. 35-1842 LANGCO. Kenneth J. Langley, and F. Brydon Smith, mgrs.

LUCEY EXPORT CORPORATION.
Dist., Wheland Co., Technical Oil Tool Corp., Drilco Oil Tools (oil industry equipment).
Buenos Aires: 320 Calle Defensa. LUCEOIL. James W. Des Champ, mgr.

MELATI, S.A.
Distributor, The Refinery Engineering Co. Engineering and construction supplies.
Buenos Aires: Patana 583. Tel. 40-1231. MELATI. B. A. Rodolfo Schwartz, pres.

MEREX ARGENTINA
Dist., Insley Mfg. (trench hoes, excavators, cranes, bucket carts).
Buenos Aires: Cangallo 537-5°.

METALIZACION ARGENTINA S.R.L.
Distributor, Metallizing Engineering Co. Metallizing equipment, and wires.
Buenos Aires: Uruguay 654, Ofic. 310/311. Tel. 328825. ALL AMERICA. J. C. Lorenzo, mgr.

MONTEJO-HNOS Y CIA.
Distributor, Tower Construction. Microwave towers, radio, and VHF towers, microwave buildings and reflectors.
Buenos Aires: Av. Cobo 1875/93. Tel. 66-8970. Carlos Montejo, mgr.

MORSE CHAIN
Oilfield supplies & engineering service.
Buenos Aires: Vaimonte 1653. Tel. 41-2346. BRYDON. Brydon Smith, mgr.

MOTO MECANICA ARGENTINA
Dist., Walworth (cast steel valves).
Buenos Aires: 25 de Mayo 611. Tel. 31-5872. Paul Chiaraviglio, mgr.

OKS HERMANOS Y CIA
Dist., Procon, Inc. (chemical & petrochemical plants).
Buenos Aires

REED ROLLER BIT COMPANY
Rock bits, tool joints, drill collars, coring equipment.
Buenos Aires: Saenz Pena 1124, Piso 8 "B" Avenida Presidente Roque. REEDBIT. Vladimir Edelberg, mgr.

SETEA
Distributor, Petro-Chem. Develop. Serice for all types fluid refinery and chemical plant heaters.
Buenos Aires: A. R. Saenz Pena 651. Tel. 34-4664. SETEA. Herman Bruner, mgr.

SMITH, WILL L., S.A.
Distributor, Armstrong Machine Works. Traps.
Buenos Aires: 44 Luis Saenz Pen.

SOCAR-SRL
Dist., Chicksan Export (swing joints, steel rotary hose, circulating heads, etc.); Bowen Itco (fishing tools, rotary jars, wire line pressure control); Jet Lube (drill collars, tool joints, casing & tubing, grease specialties).
Buenos Aires: Reconquista 341. Tel. 32-9044 and 32-9045. SOCAR. G. A. Kosciolek, mgr.

SOCIEDAD ANONIMA "ASTAR"
Dist., Petrolite (electric desalting, dehydrating, distillate treating, lube oil treating, sediment removal, catalytic sweetening).
Buenos Aires: Tucuman 1438. Tel. 403425. Lucien P. Favre, mgr.

SOC. INDUS. ELECTOR MECANICA
Dist., Insley Mfg. (trench hoes, excavators, cranes, bucket carts).
Buenos Aires: Ave. Corrientes 569.

TECNICA INDUSTRIAL MYB
Dist., Roots-Connersville Blower — Dresser Industries (blowers, gas pumps, meters, vacuum pumps).
Buenos Aires: Carlos Pellegrini 651.

TEITELBAUM, I. J.
Dist., Baker Oil Tools, (technical advice); Baash Ross, (drilling production equipment).
Buenos Aires: Defensa 320. Tel. 33-7647. TEIJAR.

SOLAR AIRCRAFT
Industrial bellows and expansion joints.
Buenos Aires: Migueletes 1074. Manuel A. Munoz, mgr.

TIPSA.
Distributor, George F. Failing Co. (drilling rigs) Continental-Emsco (drilling and producing equipment.)
Buenos Aires: Santiago del Estero 286. Tel. 37-9095. TIPSA. Mario L. Villa, pres.

VALLEJOS-BOIDI S.R.L.
Dist., Infilco Inc. Industrial filters.
Buenos Aires: Av. Velez Sarsfield 1158/74. GLENSOL. C. C. Vallejos, mgr.

WORTHINGTON, LTD.
Heating, air conditioning & refrigeration, pumps, compressors, etc.
Buenos Aires

BRANDER & CIA, S.A.
Dist., Rockwell (meters, regulators, valves).
Buenos Aires: Tacuari 318.

AUSTRIA

FRITZ TADINA
Dist., Bowen Itco, Inc. (fishing tools, rotary jars, wire line pressure control). George F. Failing Co. (drilling rigs); Jet Lube (thread compounds for drill collars, tool joints, casing and tubing, oil field grease specialties); National Supply (oilfield supplies).
Vienna: 8 Seidlgasse. Tel. 72-52-10. TADINA. Dipl. Ing. Fritz Tadina, mgr.

ELEKTROMATERIAL UND MOTOREN
Dist., Oil Well Supply (oil field supplies).
Vienna: Molkerbastei 10.

FREQUENTIS G.m.b.H.
Dist. for Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Vienna: Thaliastrasse 125.

C. & E. TREE LTD.
Dist., Security Inter'l.-Dresser Industries (drill bits).
Vienna: Grillparzerstrasse 5.

FARBER, EUGENE
Dist., DuPont Co. (polychemicals).
Vienna: Fickeysstrasse 13.

FAGRO, G.m.b.H.
Dist., Baker Oil Tools (sales representative); Shaffer Tool, (blowout preventers, flow beans, casing heads, control gates, hookups, swabs, jars, high pressure & drilling equipment).
Vienna: Pairistengasse 60.

HELLATURK, G.m.b.H.
Dist., Beryllium Corp. (copper rod alloys, casting ingots).
Vienna: Singerstrasse 8.

INGLOMARK-MARKOWITSCH & CO.
Dist., Bucyrus-Erie (oil well drills, rotary drills, construction machinery).
Vienna

INTEROWA FUER-HAAIMENDORF
Dist., DuPont Co. (elastomers).
Vienna: Johannesgrasse 26.

MERLA TOOLS
Gas lift equipment.
Vienna: Hotel St. James, Waaggasse. Wien IV. Bezirk.

SCHOELLER BLECKMANN
Dist., Ideco-Dresser Industries (drilling rigs, drilling & producing equipment).
Vienna: Wildpretmarkt 2. Tel. 63-06-91. PHOENIXSTAHL.

R. KEITH VAN SICKLE
Dist., Ideco-Dresser Industries (drilling rigs, drilling and producing equipment).
Vienna: Freyung 1. Tel. A-13545/49. TIEFBOHRSICKLE.

GEBRUDER SCHOELLER
Dist., Union Carbide Intern'l. (chemicals, molecular sieves).
Vienna

ERNST STAHL & CO.
Dist., Mack Trucks (trucks).
Vienna: Postfach 560. 25, Johannesgrasse.

STANHLANDEL G.m.b.H.
Dist., Curtis-Wright (alloy steel pressure pipe).
Lubeck: Wallhalbinsel bei der Marienbrucke 29-294. STAHLHANDEL. Dr. Otto Johnsen, mgr.

G. STOJAN
Dist., Cardwell Mfg. (portable rigs, winches, hoists, masts, drawworks).
Wien: Postamat 9. Box 61.

J. WARCHALOWSKI
Dist., Clark Bros.-Dresser Industries (compressors, engines, gas turbines).
Vienna: Wien 40/111, Paulusgasse 3.

WORTHINGTON PUMPEN UND MASCHINENBAU
Heating, air conditioning, & refrigeration, pumps, compressors, etc.
Vienna

METALL UND FARBEN
Dist., DuPont Co., (polychemicals photo products).
Vienna: Karntnerstrasse 7.

AUSTRALIA

JAMES BAYLISS CO.
Dist., Cameron Iron Works (blowout preventers, Xmas trees, valves, instruments). Bowen Itco., Inc. (fishing tool, rotary jars, wire line pressure control); Baker Oil Tools (technical advice); Chiksan Export, swing joints, all steel rotary hose, circulating heads, mud guns, reamers, disc bits, cementing hose, loading rack joints, fittings); Web Wilson (drilling tools). (Bayliss represents Baker in Australia, New Guinea & other adjacent areas — Netherlands New Guinea, New Zealand, Portuguese Timor).
Brisbane: 337 Queen Street, P.O. Box 387E-GPO. Tel. 2-7945. JAYBAYLISS. J. Bayliss, mgr.

N. C. CLARK (MACHINERY) PTY.
Dist., Cabot Shops & Franks Div. (pumping units, drilling, well servicing, etc.).
Melbourne: 143-145 Latrobe Street. Tel. FB 3112 DIKEMALS P.O. Box 1504 N. Melbourne. Norman K. Clark, mgr.

CARRIER CORP.
Air conditioning, heating, refrigeration.
Sidney: 36-40 Bourke St., 151 G.P.O. MANUWETHER, Tel. FL 3211.
Melbourne: 1 Moore St. Moonee Ponds W 4, P.O. Box 18. MANUWETHER. Tel. FU 5161, 5162, 1558.
Brisbane: 206-208 Queen St. MANUWETHER. Tel. B 1391.
Adelaide: 262 Brighton Road. Somerton Park. MANUWETHER.

ENGINEERING SERVICE CO.
Dist. GPE Controls — General Precicision. (valve, controls, processing equipment, data-logging, automatic computing, control equipment).
Sidney: 82-84 Sussex St. ENGSERVE.

GEOPHYSICAL SERVICE INTER'L.
Seismic, gravity and magnetic surveys and seismic data processing service.
Perth: Box S1 305, GPO. Tel. BW-1652, G. A. Howard, supvsr.

GILBERT LODGE & CO., LTD.
Dist., Continental-Emsco (drilling and producing equipment); Union Carbide (metal cutting tools).
Sydney: (Main office) Box 2546. Tel. 2222, 2848, 3058, 3411. GILBERTLOJ. Foster S. Martin, manag. dir.
Adelaide: 154 West Terrace. Box 848. Alex Thomson, mgr.
Brisbane: Scottish Union House, 127 Eagle St., P.O. Box 600-J. GILBERTLOG. Reginald C. Robinson, mgr.
Melbourne: Carnegie S. E. 9, Victoria, P.O. Box 40. GILBERTLOJ. Ivor Phillips, dir.
Newcastle: Broadmeadow, NSW. 237 Denison St., P.O. Box 11. GILBERTLOJ. G. W. Birrell, mgr.
Perth: 340 Hay St., Box 15, Subiaco. GILBERTLOJ. J. F. McLeod, mgr.

A. A. GUTHRIE PTY. LTD.
Dist., Traberlab, Inc. (nuclear instrumentation, radiation, detection equipment, radioactive chemicals, consulting service, isotope applications); Branson Inst. (Ultrasonic gaging & cleaning equipment, flaw detectors).
Marrickville: Guthrie House. 16-18 Meeks Rd.

JET-LUB (AUSTRALIA) PTY. LTD.
Thread compounds for drill collars, tool joints, casing and tubing, oil field grease specialties.
Perth: Wellington, Lord & Moore St. GPO-Box P-1223. Tel. M-2055. JETLUBE. E. E. Tomlinson, mgr.

C. S. J. JOHNSON
Dist., Crane Carrier Corp. (Trucks).
Sydney: P.O. Box 4971 G.P.O. C. S. J. Johnson, mgr.

LONG INDUSTRIAL EQUIPMENTS
Dist., Well Instrument Developing Co. (electric well logging equipment).
Sydney: 203a George St. Tel. BU 3692, BU 3800. LONGQUIP. H. W. G. Nobbs, mgr.

MOLE ENG. PROPRIETARY, LTD.
Dist., Oil Well Supply (oil field supplies).
Sydney: 44-46 Atchison St., St. Leonards, NSW.

OIL DRILLING & EXPLORATION
Dist., Lane Wells (technical oil field services, perforating, well logging, packers).
Sydney: 82 Elizabeth St. OIL DRILL. J. G. Antliff, mgr.

PERKINS (AUST.) PTY., LTD.
Dist., Hercules Motor Corp (Hercules and Hall-Scott gasoline and diesel engines, gasoline engines).
Lidcombe: N.S.W. Box 117. Parramatta Road. W. Noad, mang. dir.

R. M. ROBERTS CO.
Dist., Shand & Jurs (safety equipment for storage tanks, data logging, remote control equipment).
Melbourne: C1, Victoria. 100 Collins St., Tel. MF 6424. R. M. Roberts, mgr. ROBCOLCO.

TUTT-BRYANT, LTD.
Dist., George F. Failing Co. (drilling rigs); National Supply (oilfield supplies).
Rydalmere: N.W.S. South St. LEOTUTT.

VICKERS-DETROIT HYDRAULICS PTY., LTD.
Dist., Tulsa Winch Co. (winches, power take-offs, speed reducers, transmissions).
Maribyrnong, Victoria: Rosamond Road.

ANDERSONS AGENCIES PTY.
Dist., Mack Trucks.
Brisbane: 122 Margaret St. ANDGEN.

AUSTRAL ENG. SUPPLIES
Dist., T. D. Williamson (topping machines, stopples, pigs, casing seals, insulators); Dewrance & Co. (steam traps, strainers).
Sydney: 490-492 Kent St. Tel. BM-2195. A. E. Sherrell, assoc. dir.

AUSTRONIC ENGINEERING LABS.
Dist., Southwestern Ind. Electronics—Dresser Industries, (seismograph equipment).
Melbourne, Victoria: 420 William St.

BERNARD-SMITH (PTY) LTD.
Dist., Chicago Bridge & Iron, (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Sydney: Maddox St. BERSMITH-STEEL.

BRYCE, ROBERT, & CO.
Dist., Union Carbide Inter'l. (plastics, chemicals).
Melbourne

CHAMPIONS LTD.
Dist., Mack Trucks.
Adelaide: 113-119 Currie St. CHAMPMOTOR.

COMMONWEALTH INDUST. GASES
Dist., Union Carbide Inter'l. (chemical carbon specialties, heat & corrosion-resistant alloys, welding & cutting equipment).
Sydney

DEAKIN, EVANS, & CO.
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Sydney: Eagle & Charlotte Sts. DEVAN.

DETRICK, M. H., CO.
Engineered arches & walls for all types of heat enclosures.
Sydney: 167-187 Kent St. Tel. BU-4930. DETRICAUST. H. G. Thornthwaite, mgr.

ELECTRIC EQUIPMENT OF AUS.
Dist., Magnatrol (magnatrols).
Crows News, NSW: Box 29.

HARRIS, SCARFE & SANDOVERS, LTD.
Dist., Bucyrus-Erie (drills, construction machinery).
Perth

INVESTO MEG. CO. PTY.
Dist., Beryllium Corp. (copper rod alloys, castings, ingots).
Sydney: 134 Military Rd. Neutral Bay.

JOY MANUFACTURING CO.
Dist., Cardwell Mfg. (portable rigs, winches, hoists, drawworks).
Rosebery, NSW: 56-58 Rothschild Ave. Box 63. Tel. FF-4163FF-3512.

MALCO INDUSTRIES
Dist., Dresser Mfg. Div. (couplings, pipe clamps, sleeves, etc.).
Marrickville, NSW: Rich Street.

MINDRILL LTD.
Dist., American Iron & Machine, (packers, overshots).
Melbourne, Victoria: 86-106 Plenty Road. Preston, N. 18. P. J. Kirkwood, mgr.

MOORE ROAD MACHINERY
Dist., Mack Trucks.
Melbourne, Victoria: Williamstown Road. EARTHMOVE.
OILFIELD SUPPLY PTY. LTD.
Dist., Security Inter'l.—Dresser Industries, (oil, gas, chemical equipment).
Sydney: 82 Elizabeth St.
PROCON PTY. LTD.
Chemical, petrochemical, petroleum plants.
Sydney
P. ROWE, PTY.
Dist., DuPont Co., (polychemicals).
Sydney: 297-299 Castlereagh St.
Melbourne: 107/9 Flinders Lane.
RUSTON & HORNSBY (AUST).
Dist., Bucyrus-Erie (oil well drills, rotary drills, construction machinery).
Adelaide
Artarmon
Brisbane
WELDING DISTRIBUTORS PTY.
Dist., Curtis Wright (alloy steel pressure pipe).
Dulwich Hill, NSW: 382 Canterbury Road, Tel. LM 1334. W. Bernard, dir.
R. WERNER & CO.
Dist., Marley Co., (cooling towers).
Melbourne: 54-86 Burnley St., Richmond. Tel. JB-3711. WERNERCO. Len Clough, mgr.
WESTINGHOUSE BRAKE (AUS).
Pneumatic controls for oil industry, hydraulic surge dampening.
New South Wales: Box 21 P.O. Burwood. Frank Speight, mgr.

BELGIUM

ARSENE PARDON & CIE
Dist., Mexico Refractories Co. (refractory castables, mortars, ramming materials, firebrick).
Brussels: 112 rue Malibran. Tel. 47-87-44. FUMISTRA. Arsene Pardon, mgr.
ATELIERS JASPER, SA
Dist., Dewrance & Co. (steam traps, strainers).
Liege: 2 Rue Jonfasse.
CODI, S. A.
Dist., Amercoat Corp. (protective coatings, vinyls, epoxies, Dimetcote).
Brussels: 23 rue Royale.
CEGEAC COMPAGNIE GENERALE d'AUTOMOBILE ET d'AVIATION
Dist., Hercules Motors Corp. (Hercules and Hall-Scott gasoline and diesel engines, gasoline engines).
Brussels: 13 rue de Brederode. H. Bullen, mgr.
E.G.E.A.
Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Brussels: 140 rue de Stalle.
HYDROBEL
Dist., Olin Cuno Filter (industrial filters): Chiksan Export (swing joints, steel rotary hose, circulating heads, mud guns, etc.).
Liege: 98 Quai Vercour. OLCUNO or HYDROBEL. Andre Genette, mgr.
MARINE MOTORS AGENCIES, S.A.
Dist., Hercules Motors Corp. (Hercules and Hall-Scott gasoline & diesel engines, Lycoming gasoline engines).
Antwerp: Verbindingsdok. J. C. Dekker, dir.
N. V. EMBA AGENTUREN
Dist., Shand & Jurs (valves, controls, processing, equipment, data-logging, automatic computing and control equipment).
Antwerp: No. 168 Amerikalei. Tel. 38 48 33 - 38 48 41.
SOC. ANONYME BELGE HEURTEY
Dist., Petro-Chem Development (service for all types of fluid refinery and chemical plant heaters).
Liege: 16 Quai Churchill. Tel. 43-45-97. J. Margulies, mgr. GAZHEURTEY.
ATLANTIC TRADING CO.
Dist., DuPont Co. (photo products, chemicals, petrochemicals, polychemicals, elastomers).
Brussels: 294. Rue Royale.
AUTOMOBILES MIESSE S.A.
Dist., Mack (trucks).
Brussels: 28-46 Rue des Goujons. AUTOMIESSE.
BORG-WARNER INT'L.
Dist., Morse Chain (oilfield supplies, engineering services).
Brussels: 142 Ave. G. E. Lebon. Tel. 33-4616. BORINTCO. H. I. Hellman, mgr.
ETUDES ET RECHERCHES INDUSTRIELLES
Dist., Clark Bros. (compressors, engines, gas turbines).
Brussels: 79 Blvd. Clovis.
ETABLISSEMENTS A. BRUYAUX
Dist., Hills McCanna (diaphragm valves, chemical, metering & proportioning pumps); Dresser Mfg. (pipe clamps, fittings, couplings).
Brussels: 244-250 Rue De La Loi.
ETABLISSEMENTS EMERIC KROCH
Dist., Vapor Recovery System (storage & transportation of liquids).
Brussels: 75 Blvd. Clovis. Tel. 33.98.42-45. KROCHEM. Emeric Kroch, mgr.
MARKT & CO.
Dist., Beryllium (copper rod alloys, casting ingots).
Brussels: Rue de la Caserne, 88.
SIMDIS
Dist., Oakite Products (cleaning & descaling compounds).
Brussels: 68-69 Blvd. Poincare. L. Tonglet, mgr.
SOCIETE AUDCO BELGE
Dist., Edward Valves (steel, cast & forged valves).
Brussels: 162 Ave. Louise. Tel. 47/26. 39. F. O. Spitzer, mgr. AUDCOBEL.
UNION CHIMIQUE BELGE
Dist., Selas Corp. (tubular furnaces for continuous processing burners, dehydrators).
Brussels: 61, Ave. Louise. Tel. 37.12.20. UNICOKE. E. Leurquin, mgr.
WESTINGHOUSE CO. BELGE DES FREINS.
Pneumatic controls for the oil industry, hydraulic surge dampening.
Brussels: Ave. Louise 97. Charles Gerard, mgr.
A. WOLTERS
Dist., Ideco-Dresser Industries (drilling rigs).
Brussels: 6 Rue de la Dyle. Tel. 18-43-00. BELGUMRUBBER.

BOLIVIA

CARLOS MIGUEL HERMANOS
Dist., Infilco, Inc. (industrial filters).
La Paz: Mercado 462-466. Tel. Casilla 174.
COMPANIA DE PERFORACIONES
Dist., George F. Failing (drilling rigs); Oil Well Supply (oilfield supplies); Baker Oil Tools (technical advice).
La Paz: Edificio Redentoristas 3rd, Avenida Camacho No. 45. COPER. Jorge T. Lavadenz, mgr. F. S. Galvarro, pres.
DEL PRADO AND CO., LTDA.
Dist., Axelson Division, U. S. Industries (pumps, rod liners); Rockwell (valves, meters, regulators).
La Paz: Ave. 16 de Julis No. 92. Casilla 172 and 147.
EQUIPO PETROLERO, LTDA.
Dist., Cameron Iron Works (blowout preventers, Xmas trees, valves and instruments).
La Paz: Casilla 1359. Tel. 10977. EQUIPETROL. Alberto M. Vasquez, mgr.
GEOPHYSICAL SERVICE INTERN'L.
Seismic, gravity and magnetic surveys and seismic data processing services.
Cochabamba: Casilla 1437. R. H. Mathews, supvsr.
INTEROIL, S. A.
Dist., Continental Emsco (drilling and producing equipment); Black, Sivalls and Bryson (oilfield equipment).
La Paz: Casilla Correos 260. Tel. 8983. INTEROIL. Guillermo Mariaca, mgr.
LARRY KLINE
Dist., Petroleum Helicopters, Inc. (helicopter service).
Cochabamba: Casilla 1662. BOGOC.
OBRIST & CIA., LTD.
Dist., Mexico Refractories Co. (refractory castables, mortars, ramming materials, firebricks); DuPont Co. (chemicals, explosives).
La Paz: P.O. Box Casilla 214. Tel. 3122. VOLCAN. E. Anliker, mgr.
OIL INDUSTRY SUPPLY & SERVICE
Dist., Bowen Itco., Inc. (fishing tools, rotary jars, wire line pressure controls); Drilco Oil Tools, Inc. (drill collars, subs, drill collar stabilizers, rotary reamers, drill collar torque indicators, portable drill collar field inspection units); Brown Oil Tools (string packers); Perforating Gun Atlas (wire line services - logging, perforating); Barton Instruments (twin bellow flow meters); Chiksan Export (swing joints, steel rotary hose, circulating heads, mud guns, etc.); Web Wilson Tools (drilling tools); Cardwell (portable rigs, winches, hoists, masts, drawworks).
La Paz: Casilla 1268. Tel. 3917. OISSCO. C. Tarborga, Miguel Angel Roca, Alberto M. Vazquez, mgrs.
PENARANDA Y CIA
Dist., Cabot Shops, Frank Div. (pumping units, drilling equipment, etc.).
La Paz: Casilla 347. Tel. 3051-4889. Gonzalo Penaranda, mgr.
ARGO LTDA.
Dist., American Iron & Machine (packers, overshots).
La Paz: Casilla Correo 676. Calle Bueno 46-esq. Frederico Zuazo. Guillermo Mariaca, mgr.
APPLEGATE OIL FIELD SUPPLY
Dist., Milwhite Mud Sales (drilling mud supplies).
Cochabamba: Casilla 399. Tel. 4474. AGATE. D. V. Applegate, mgr.
BOLIVIAN OXYGEN CO.
Dist., Union Carbide Inter'l. (welding & cutting equipment).
La Paz
CO. IMPORTADORA BOLIVIANA S.A.
Dist., National Supply (oilfield supplies).
La Paz: Av. Mcal. Santa Cruz No. 77-79. Ed Medina. Casilla 954. CIBO. Tel. 2802.
CORPORACION COM. BOLIVIANA,
Dist., Security Inter'l.-Dresser Industries (drill bits); Dresser Mfg. (couplings, pipe clamps, sleeves, etc.).
La Paz: Casilla de Correo 778.
FEDERICO A. EULERT S. EN C.
Dist., Mack.
La Paz: Casilla de Correo 351. Ave., Ill. No. 204.
INTERNATIONAL MACHINERY CO.
Dist., Bucyrus-Erie (drills, construction machinery).
La Paz

MAC DONALD & CO.
Dist., DuPont Co. (finishes).
Oburo: Casilla 375.
La Paz: Box 879.
Cochabamba: Box 499. Nathaniel Aguirre 149/157.
Sucre: Box 159.

NATIONAL SUPPLY CO.
Dist., W. H. Curtin (lab apparatus, petroleum testing equipment, reagent chemicals).
La Paz: Casilla 883. Tel. 6967. NASUCO.

SOCIEDAD ANONIMA VOLCAN
Dist., DuPont Co. (polychemicals).
La Paz: Casilla 214.

BRAZIL

AMBRIEX, S. A.
Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Rio de Janeiro: Avenida Grace Aranha, 57, 5° Andar, Grupo 510.

BALDWIN-LIMA-HAMILTON do BRAZIL, S. A.
Cranes, crawler, wheel and truck mounted, and other construction material.
Sao Paulo: Rua Libero Badaro, 582-10° Box Caixa Postal 90. Tel. 37-5586. LIMASHOVEL. W. D. Ellis, mgr.

BAHEMA, S. A.
Dist., LaTourneau-Westinghouse (construction machinery).
Salvador, Bahia: Av. Frederico Pontes n.94-A. BAHENGI.

BLACK, SIVALLS AND BRYSON do BRASIL
Oilfield equipment.
Rio de Janerio: Caixa Postal 2288. BLACKSILO.

BROWN & ROOT, LTDA.
Engineering, design, project management, construction and maintenance services.
Sao Paulo: Caixa Postal 5636. Tel. 35-97-81. BROWNBILT. J. S. Burrows, Jr.

DINACO, LTDA.
Dist., Black, Sivalls & Bryson (oil field equipment).
Sao Paulo: Caixa Postal 6645.

CASCADURA CROMEACAO DURA
Dist., Metallizing Eng. Co. (metallizing equipment, wires).
Sao Paulo: Caixa Postal 359. WALEONI. W. Leoni, mgr.

AMERICANA DE INTERCAMBIO
Dist., Cabot Shops, Inc. and Frank Div. (pumping units, drilling and well service and workover equipment).
Rio de Janeiro: Rua Teofilo Otloni, 15. Tel. 22-2147. CADIB. Carlos De Figueiredo Braga, mgr.

NATIONAL DE SONDAGENS
Dist., Kerotest Mfg. Co. (cast steel valves, gate, globe, angle, check, pipeline, flow line drilling); American Iron & Machine (packers & overshots); Grant Oil Tool, (drilling tools & production equipment).
Rio de Janeiro: Av. Rio Branco 25-10. Tel. 23-5952. SONDA. Pio Castagnoli, mgr.

COMMERCIAL E INDUSTRIAL DE FORNOS WERCO, LTDA.
Dist. Shand and Jurs—GP sub. (safety equipment for storage tanks, automatic level gages, indicators, remote control equipment and data-logging); GPE Controls—GP sub. (valves, controls, processing equip., data-logging, automatic computing, control equip.); Petrolite (chemical demulsifiers, desalters, corrosion inhibitors, paraffin removers, water flood additives, etc.); Dresser Industries — Security Inter'l. (valves, alloys, rock bits); Magnet Cove Barium (drilling muds and chemicals).
Rio de Janeiro: Rua General Gurjao, 326. RIOWERCO. General R. I Guerreiro, mgr. (GP) M. M. Ferraz, mgr. (Dresser).

COMPANHIA EXPRESSO FEDERAL
Dist., Hercules Motors Corp. (Hercules and Hall-Scott gasoline engineers and diesel engines, Lycoming gasoline engines).
Rio de Janeiro: Av. Rio Branco, 87. Caixa Postal 220. H. F. Covington, pres.

EDWAR MAQUINAS DE BRAZIL
Dist., Modern Engineering Co. (oxyacetylene welding and cutting apparatus and supplies).
Rio de Janeiro: Rua Debret, 79 — Grupo 705.

EQUIPAMENTOS GERAIS, LTD.
Dist., Cameron Iron Works (blowout preventers, Xmas trees, valves & instruments), and Lucey Export Corp (oil industry supplies); Web Wilson (drilling tools).
Rio de Janeiro: Rua de Quitanda 80-10° Andar. Tel. 43-3082. OBERPAN. Oscar Bernardes, mgr.

FOOD MACHINERY, LTDA.
Dist., John Bean Division, Food Machinery and Chemical Corp. (core drilling pumps, high pressure piston pumps, thread compound, stationary and portable fire fighting equipment).
Sao Paulo: Caixa Postal 11.717 Lapa. BEANSPRAY. C. A. MacRae.

FORMAC, S. A.
Dist., Continental-Emsco (drilling and producing equipment); Solar Aircraft (gas turbine engines); Insley (trench hoes, cranes, excavators, bucket carts).
Rio de Janeiro: P.O. Box 1310. Tel. 43-5818. FORMAC. Rudolf Heinz, pres.

GEOHYDRO-ENGENHARIA E COMERCO, S. A.
Dist., Oil Well Supply (oilfield supplies); George F. Failing (drilling rigs).
Rio de Janeiro: Edificio Rio Parana, Rus Visconde de Inhauma, 134. Tel. 23-2080. Reda Interna, mgr.

GEOPHYSICAL SERVICE INT'L, LTD.
Seismic, gravity and magnetic surveys and seismic data processing services.
Rio de Janeiro: Avenida Rio Branco 25. Tel. 23-0794. P. S. Stoutjesdyk, opera. mgr.
Belem, Para: Cx. Postal 820. Tel 5056. P. E. Swenson, supvsr.

HERO HIDROELECTRA COMMERCIAL, SA
Dist., Armstrong Machine Works (traps).
Sao Paulo: Caixa Postal 2835.

HUDSON ENG. CORP.
Process plants.
Rio de Janeiro: Rua Mexico 45.

IND. BRASILEIRA DE EMBALAGENS
Dist., Columbian Steel Tank (storage tanks and truck tanks).
Sao Paulo: Rua Clelia, 93. Caixa Postal 5659. Tel. 62-3121. GELIBESA. I Kleinberger, mgr.

LUCEY EXPORT CORP. (EQUIPAN)
Dist., Drilco Oil Tools, Wheland Co., Parkersburg Rig and Reel, Technical Oil Tool (oil industry equipment and supplies).
Rio de Janeiro: Rua Da Quitanda, 80-10° Andar. Oscar de Paula Bernardes Filho, mgr. OBERPAN.

MAQUIP, S. A.
Dist., Bowen Itco (fishing tools, rotary jars, wire line pressure control); Jet Lube (thread compounds for drill collars, tool joints, casing and tubing, oil field grease specialties); Axelson Division, U. S. Industries (pumps, rod liners); Martin-Decker (indicating & recording drilling control instruments); Baker Oil Tools—(technical advice); Chiksan Export (swing joints, all steel rotary hose, circulating heads, reamers, etc.); Lane Wells (technical oil field services, perforating, well logging, packers).
Rio de Janerio: Av. Rio Branco 52-11° Andar. Tel. 23-5840. P.O. Box 2508. Benjamin Sodre, Jr. SOCILEQUIP.
Salvador: Box 1349. Ricardo Osborn.

MATERIAS TECNICOS DE PETROLEO, S. A.
Dist. Bethlehem Steel (drilling, production, and pipe line equipment, general supplies, waterflooding services); Baash-Ross (drilling production equipment); Milwhite Mud Sales (drilling mud and engineer service); Cardwell (rigs, trenches, hoists, masts, drawworks); Rockwell (meters, regulators, valves).
Salvador, Bahia: Av. Frederico Pontes 90-A. J. C. Laport, mgr.

NORDRY LIMITADA
Dist., Houdry Processes (Houdry process).
Rio de Janeiro: Av. Rio Branco, 185, Suite 1320. Tel. 22-9016. Jorge O. Noronha, mgr.

MESBLA, S. A.
Dist., D. W. Onan & Sons, Inc (electric plants, generators, air-cooled engines).
Rio de Janeiro: Rua do Passeio, 42/56. Caixa Postal 1040.
Salvador: Av. Frederico Pontes, 98, 102/104.
Sao Paulo: Rua 24 de Maio, 141.

ORGANIZACAO BRASILEIRA DE APLICACOES INDUSTRIAIS, S. A.
Dist., McCullough Tools (wire line and fishing tools).
Rio de Janeiro: Rua Mexico 45-11, Andar. Caixa Postal 472. Tel. 42-8368. SEMINAL. H. V. Lage, mgr.

PROPAC (Comercio E Industria)
Dist., Carrier Corp. (air conditioning, refrigeration, heating).
Rio de Janeiro: Caixa Postal 2168. Av. Rio Branco, 85-14° Andar. PROPAC. Tel. 23-2101.
Sao Paulo: Rua Alvares Penteado 208-8°. Box 3014. Andar Tel. 25-4101. PROPAC.

SEISA — EXPORTACAO IMPORTACACAO
Dist., Yarnell-Waring (blow-off valves, water gages, liquid level indicators, expansion joints, steam traps, strainers).
Rio de Janeiro
Sao Paulo
Porto Alegre

SOCIEDADE IMPORTADOR DE EQUIPAMENTOS
Dist., Equipment Engineers (tension tubing anchors, tubing anchors, tubing catchers/anchor, swabs, hydraulic line strippers, sucker rod strippers, polished rod blowout preventers, polished rod lubricators, stuffing boxes); Midwestern Pipe Line Products (pipe wrapping materials); Garrett Oil Tools, Division of U. S. Industries (gas lift equipment, motor valves and controllers, lease automation equipment, safety valves); Vapor Recovery System (storage & transportation of liquid equipment).
Rio de Janeiro: Avenida Franklin Roosevelt, 39-14 Andar S/1408. Tel. 32-8209, 52-2748, Caixa Postal 4170, GAWISCH. Jorge Greenhalgh, mgr., and Gabriel Filgueiras.

SONDA, S. A.
Dist., Christensen Diamond Products (diamond coring, drilling equipment); Oil Metering and Processing Equip. (crude oil metering and testing equipment).

Rio de Janeiro: Av. Rio Branco, 25-10° and Grupo B. Tel. 23-5952. Pio Castagnoli, mgr.

TECNICA E. REPRESENTACOES TRACTOBRAS, LTDA.
Dist., Marmon-Herrington (Fords).
Sao Paulo: Ave. Conceicaco 383-20 Conj. Caixa Postal 3062. TRACTOBRASILIA. Edmund J. Miessler, mgr.

WORTHINGTON, S. A. (Maquinas)
Heating, air conditioning, pumps, compressors, etc.
Dist., Wheaton Brass Works (valves and fittings).
Rio de Janeiro: Rua Santa Luzia, 685-6° And. C. Postal 170. Tel. 32-4394. W. C. Compson, mgr. WORTHINGTON.

BILESKI, KURT
Dist., Foxboro Co. (industrial instruments).
Sao Paulo: Rua 7 de Abril 404, 12°. Caixa Postal 5837. Tel. 35-6088. FOXBILESKI.

BRASILEIRA DE MATERIAIS
Dist., Mack (trucks)
Rio de Janeiro: Rua Mexico 74, 10° Andar.

CHICAGO BRIDGE CONSTRUCOES
Oil storage tanks, evaporation saving equipment, refinery vessels, steel construction.
Rio de Janeiro: Avda General 275. Grupo 705. Tel. 22-2792. CHIBRIDGE. G. O. Penna, mgr.

DU PONT DO BRASIL, S.A.
Photo products, polychemicals, finishes, elastomers.
Rio de Janeiro: Caixa Postal 710.

EXPANS S/A COMERCIO E INDUS.
Dist., Mack (trucks).
Sao Paulo: Caixa Postal 2274. Praca de Republica, 497: 6° Andar. EXPAN.

FARROW, W. L.
Dist., Ideco-Dresser Industries (drilling rigs, drilling & producing equipment).
Rio de Janeiro: Rua de Quintanda. 20 Sala 801. Tel. 42-7623. INTDRESSER.

FORD, HENRY
Dist., Ideco-Dresser Industries (drilling rigs, drilling & producing equipment).
Salvador: Ed. Tijupa, Ave. Centenairo 35. Nesta, Apt. 301.

GENERAL MOTORS DO BRASIL
Diesel engines, vehicles, spare parts.
Sao Paulo: Rua Goias, 1805. Sao Caetano Do Sul. Tel. 32-2189, 32-1045, 32-8076. **BRAZAUTOEX.**

HUNNICUTT & CIA, LTDA.
Dist., Marley (cooling towers).
Sao Paulo: Rua da Fiandeiras, 90. Tel. 61-3079. Caixa Postal 7106. SPRAYSYSCO. John E. Hunnicutt, mgr.

KELLOGG BRASILEIRA
Dist., M. W. Kellogg (engineering, procurement, construction of refineries).
Rio de Janeiro: Av. Rio Branco 57. 16° Andar. Tel. 23-1938. BRASKEL. D. R. McKinney, mgr.

LAGE, H. V.
Dist., Barton Instruments (twin bellow flow meter).
Rio de Janeiro: Rua Mexico 45. Tel. 42-8368.

LANGLEY & CIA
Dist., T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).
Rio de Janeiro: Rua Mexico 45. H. V. Lage, mgr.
Sao Paulo: Rua 24 de Maio 276. 13° Andar. Sala 136.

LEAO, FONTES & CIA
Dist., Beryllium (copper rod alloys, castings, ingots).
Sao Paulo: Box 3238.

PEDROSO, Gen. Heitor
Dist., Ideco (drilling rigs, drilling & producing equipment).
Rio de Janeiro: Rua de Quintanda, 20 Sala 801. Tel. 42-7623. BISPETRO.

PROMON ENGENHARIA
Dist., Procon Inc. (chemical, petrochemical, petroleum plants).
Rio de Janeiro

S. A. WHITE MARTINS
Dist. Union Carbide (welding & cutting equipment).
Rio de Janeiro

SOCIEDADE TECNICA E COMMERCIAL
Dist., National Supply (oilfield supplies).
Rio de Janeiro: Rua Teofilo Otoni 123-A 6° Andar. Caixa Postal 3167. TECRIO.

WESTINGHOUSE AIR BRAKE TRADE
Pneumatic controls for oil industry, hydraulic surge dampening.
Sao Paulo: Caixa Postal 7128. D. J. Price, mgr.

UNION CARBIDE DO BRASIL
Plastics, chemicals, etc.
Rio de Janeiro
Sao Paulo

MONTREAL-MONTAGEM E REP. INDUS. SA
Dist., Johns-Manville (insulation materials).
Sao Paulo: Pca. da Republica, 272-G/62. Tel. 37-1624. BRASMONSAEL. Roberts Bergallo, dir.

MATEP
Dist. Le Bus Inter'l. Engineering (grooving & controlled counterbalance wire line spooling systems).
Rio de Janeiro: Caixa Box 2824.

CHILE

DINASUR, LTD.
Dist., Yarnall-Waring (blow-off valves, water gages, liquid level indicators, expansion joints, team steam traps, strainers. CONCEPCION.

DISTRIBUIDORA NACIONAL
Dist., LeTourneau-Westinghouse (construction machinery).
Santiago: Maquinarias Codina. Casilla 184-D. Augustinas 1343. CODINA.

GILDEMEISTER, S. A. C.
Dist., Black, Sivalls & Bryson (oil field equipment); Cardwell (rigs, winches, masts, drawworks, trenches); Clark Bros. — Dresser Industries (compressors, engines, gas turbines).
Santiago: Agustines IIII, Casilla 99D. GILDEMEIST.
Puntarenas: Casilla 457.

JACARD Y PEREZ, LTDA.
Dist., Hercules Motors Corp. (Hercules and Hall Scott gasoline & diesel engines, Lycoming gasoline engines).
Santiago: Casilla Postal 1679. Alberto Perez C., gen. mgr.

A. MONTERO Y CIA
Dist., D. W. Onan and Sons (electric plants, generators, air-cooled engines); Beryllium (copper rod alloys, castings, ingots).
Santiago: Av. B. O'Higgins Esq. San Martin. Casilla 312.

ACHURRA, LUKSIC & CO.
Dist., Southwestern Ind. Electronics-Dresser Industries (seismograph equipment).
Santiago: Pedro Leon Ugalde 86. Oficina 703.

ENGEL & CO.
Dist., DuPont (explosives).
Santiago: Casilla 3445.

FORAM CHILENA, LTDA.
Dist., National Supply (oilfield supplies); Foxboro (industrial instruments).
Santiago: Huerfanos 812, Room 506. Box 2796. FORAM. Tel. 39-7515/6. Gustavo Valenzuela, pres.

GRACE Y CIA
Dist., Bucyrus-Erie (drilling rigs, construction equipment).
Santiago
Antofagasta

GRAHAM, W. E.
Dist., Web Wilson (drilling tools).
Santiago: Casilla 13119.

GULER, ERNESTO E.
Dist., Aeroquip (aviation & hydraulic equipment).
Santiago: Estado 235, Of. 509

HOCHSCHILD, MAURICIO Y CIA
Dist., Dresser Industries-Dresser Mfg. (couplings, pipe clamps, sleeves, etc.); Security Inter'l. (valves, alloys, rock bits).
Santiago: Casilla 153-D.

IMPORTADORA & EXPORT. DAVISCO
Dist., DuPont Co. (photo products).
Santiago: Casilla 273-V.

MANUAL CUADROS & CIA
Dist., Chiksan Export (swing joints, steel rotary hoses, circulating heads, mud guns, fittings, disc bits, etc.).
Santiago: Ed. Grace, Huerfanos 1189. Casilla 3440. Tel. 6-0214 & 8-5496. Manuel Cuadros Cerda, mgr.

MITCHELL, O.H. & CIA
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Santiago: Casilla 1014.

PEREZ, REITZE & BENITEZ
Dist., DuPont (polychemicals, finishes, elastomers).
Santiago: Casilla 2842.

SALFA, SACI
Dist., Mack (trucks).
Santiago: Casilla 1089.

SERGIO VERGARA
Dist., Gulf States Asphalt (asphalt roofing & specialty products, pipe enamel, canal & reservoir lining).
Santiago: Nueva York 52. Of. 704. Tel. 86000-68383. Sergio Vergara Bruce, mgr.

SPENCER, JAMES, H. & CIA
Dist., DuPont (explosives).
Santiago: Agustinas 785. Of. 460.

SOCIEDAD IMPORTADORA DEL PACIFICO
Dist., Rockwell (meters, regulators, valves).
Santiago: Casilla 82-D.

SUD AMER DE EXPLOSIVES
Dist., DuPont (explosives).
Santiago: Casilla 13620, Correo 15. Gary White, asst. gen. mgr.
Santiago: Av. B. O'Higgins Esq. San Martin. Casilla 312.

SERGIO LORENZEN
Dist., Mexico Refractories, Co. (refractory castables, motars, ramming materials, firebrick).
Santiago: Nueva York 57-5° Piso. P.O. Box Casilla 13396. Tel. 69224. Sergio Lorenzen, mgr.

LUKSIC Y CIA, LTDA.
Dist., Continental-Emsco (drilling and producing equipment).
Santiago: Casilla 13477, Correo 15, Tel. 67437. LOCOL. D. B. Luksic, mgr.

MARIO ALDUNATE MOREL
Dist., Christensen Diamond Products (diamond coring, drilling equipment).
Santiago: Casilla 240. Tel. 67629. Mario Aldunate Morel, mgr.

SOCIEDAD GENERAL DE COMERCIO
Dist., Marmon Herrington (Fords).
Santiago: Alameda Bernardo O'Higgins No. 1170. Casilla 904. Tel. General 69155. SOGECO. Pablo Parant P., mgr.

SOCLIMA—S CARRASCO, S.A.C.
Dist., Carrier Corp. (air conditioning, refrigeration, heating).

Santiago: Nuble 72. Casilla 3028. Tel. 53028. RADIADOR.

WILSON, KING, & CIA

Dist., D. W. Onan & Sons (electric plants, generators, air-cooled engines).

Puenta Arenas: Castilla 22D.

COLOMBIA

A-Z EXPORT

Dist., Bowen Itco (fishing tools, rotary jars, wire line pressure control); Ideco-Dresser Industries (drilling rigs, drilling & producing equipment): Chiksan Export (swing joints, steel rotary hose, circulating heads, mud guns, disc bits, fittings, etc.); Le Bus Inter'l. Engineering (grooving controlled counterbalance wire line spooling systems).

Bogota: Calle 19, No. 7-30. M. R. Vollmer and Mel Cooper, mgrs.

ARTURO SAMUDIO & CIA

Dist., Mexico Refractories Co. (refractory castables, mortars, ramming materials, firebrick).

Barranquilla: Calle 34, No. 48-129. Apartado Aereo 1163. Tel. 12-199. ARSAMUDIO. Alirio Llinas, Jefe de Ventas, mgrs.

AMERICAN PIPE AND CONSTRUCTION INTER'L.

Cement mortar lined and coated steel cylinder pipe.

Bogota: Calle 14 12-50. Apartado Aereo 7673. Tel. 434-412. CONTUB. W. E. Rodes, mgr.

LEON BOYD

Dist., Petroleum Helicopters (helicopter service).

Bogota: Apartado Aereo 8614. PETHELICO.

CENTRAL AMERICANA DE DISTRIBUCION LTDA.

Dist., Tulsa Winch (winches, power take-offs, speed reducers, transmission); Marmon Herrington (Fords).

Bogota: Carrera 10, No. 13-61 Piso 5. Box 3499. CADIS. Michel Estefan, mgr.

COLOMBIA PETROLEUM DEV. & CONSULTANT

Dist., Continental-Emsco (drilling and producing equipment); Marlow Pumps Division Bell & Gossett Co. (pumps).

Bogota: Apartado Aereo 3715. Tel. 421196. PETROCON. Alvaro Lopez, Edgar Clayton, mgrs.

CONTINENTAL-EMSCO CO.

Drilling and producing equipment.

Bogota: Apartado Aereo 5700. Tel. 452-459. CONEMSCO. F. W. Dawson, rep.

CURACAO TRADING CO., S. A.

Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).

Bogota: Calle 13, No. 13-22.

DEUBNER & RICO, LTDA.

Dist., J. H. Williams & Co. (wrenches, sockets, chain pipe tongs & vises.

Bogota: Calle 13, No. 9-20. Tel. 42-22-67. P.O. Box 4219. DEUBNER. Ariosto Rico B., Mgr.

FABRICA NACIONAL DE OXIGENO Y PRODUCTOS METALICOS

Dist., Modern Engineering Co. (oxyacetylene welding and cutting apparatus and supplies).

Bogota

GEOPHYSICAL SERVICE INTER'L.

Seismic, gravity, and magnetic surveys and seismic data processing services.

Bogota: Seguros Bolivar Bldg., Apartado Aereo 7340. Murrell Holbert, Supvsr.

GRANCOA (Grancolombina de Agencias, Ltd.)

Dist., Hercules Motors Corp. (Hercules and Hall-Scott gasoline engines, Lycoming gasoline engines).

Bogota: Apartado Aereo Avianca 4805. Gene A. Marusi, gerente.

FERRETERIA AMERICANA

Dist., Wheaton Brass Works (valves, fittings).

Bogota: Calle 12 No. 9-46. Jacques A. Sid, mgr.

INDUSTRIA CERAMICA, LTDA.

Dist., Mexico Refractories (refractory castables, mortars, ramming materials, firebrick).

Bogota: Transversal 63, No. 74-83. Apartado Aereo 4829. Tel. 40-04-04 and 40-03-64. INDUCER. Andy Moser B., mgr.

INTERCOLOMBIANA, LTDA.

Dist., George F. Failing (drilling rigs).

Bogota: Apartado 48-84. Edificio Bolsa de Bogota.

MOTORES, S. A.

Dist., Oil Well Supply (oilfield supplies); Phelps Dodge Copper (wire, cable, pipe, tube).

Bogota: Carrera 13, No. 13-17. Box 6801. Tel. 431023. Carlos Bejarano, Mgr.

OIL FIELD SALES & SERVICE, S. A.

Dist., Garrett Oil Tools (gas lift equipment, motor valves and controllers, lease automation equipment, safety valves); Axelson, Division, U. S. Industries (pumps, rod liners); Waukesha (gasoline engines).

Bogota: Apartado 8586. Mitchell W. Breedlove, mgr.

L. y R. PELAEZ and VILEZ ANGEL, LTD.

Dist., Infilco, Inc. (industrial filters).

Barranquilla: Apartado Aero 1163. Tel. 3461. PELAEZERE. Artiro Samudio, mgr.

Medellin: Apartado 2084. Tel. 144-53 and 162-37. PELAEZERE. Dr. Luis Pelaez, Rafael Pelaez, mgrs.

Bogota: Calle 13, Num. 21-36. Tel. 73-374 & 74-192. PELAEZERE. Alberto Velez Angel, Mgr., Victor Faza H., Alberto Mesa.

REPRESENTACIONES TECNICAS

Dist., Metallizing Engineering Co. (metallizing equipment, wires).

Bogota: Apartado Aereo 3708. P.O. Box Calle 13 9-33. Oficina 307. ALL AMERICA. N. W. Duffus, mgr.

TECHNICIA COLOMBIANA, S. A.

Dist., Armstrong Machine Works (traps).

Bogota: Carrera 5a, No. 16-14.

VOLCO, INC.

Dist., Oil Base, Inc. (field engineering service).

Bogota: Calle 19, Numero 7-30. Tel. 432-487. M. R. Vollmer, mgr. VOLCO.

ARMCO COLOMBIANA

Dist., National Supply (oilfield supplies).

Barranquilla: Calle 37 No. 39-51. Tel. 10480 (office) 61037 (warehouse). ARNCIUSA.

ANGEL E. CHAVEZ L.

Dist., Aeroquip (aviation equipment, hydraulic equipment).

Cali: Apartado Aereo 4478.

CABARRIA, LTD.

Dist., DuPont (explosives, polychemicals, elastomers, photo products).

Barranquilla: Apartado Aereo 690. Nac. 761.

Bogota: Apartado Aereo 3651, Nac. 2734. Carrera 13, No. 16-48.

Cali: Apartado Aereo 86, Nac. 549.

SCHWARZENBACH, ENRIQUE

Dist., Rockwell (regulators, valves, meters).

Bogota: Apartado Aereo 84800.

CODEP, LTDA.

Dist., Cardwell (rigs, winches, drawworks, masts, trenches).

Bogota: Calle 13. No. 43-86. Box 4912.

COLTECH

Dist., Petroleum Technologists (core analysis, flood & PVT lab).

Bogota: Calle 13. No. 42-35. Tel. 47 08 03. Box 80-46. COLTECH. James D. Richards, mgr.

CORE LAB. INT'L.

Mud logging, core analysis, reservoir engineering.

Bogota: Calle 53 No. 26-29. Tel. 48-9922. Apartado Aereo 1875. James A. Cusator, mgr.

FABRICAS COL. DE MAT. ELECT.

Dist., Phelps Dodge Copper (copper wire & cable).

Cali: Carrera 1A. No. 37-06. Tel. 88444. Box 1820. FACOMEC. Gosta Stodberg, mgr.

GENERAL ELEC. DE COLOMBIA

Dist., Bucyrus-Erie (drilling rigs, construction equipment).

Bogota

Barranquilla

Cali

Medellin

HIJUS DE RICARDO GREIFFENSTEIN

Dist., Rockwell (regulators, meters, valves).

Medellin: Postal 175. Almacen Luz, mgr.

JOSE CURE B.

Dist., Mack (trucks).

Barranquilla: Apartado Aereo 452. JCURE.

LEON, J. EUSEBIO

Dist., Insley (trench hoes, excavators, cranes, bucket carts).

Bogota: Aptdo. Aero 4530.

MANGNER & VILLA

Dist., Dresser Mfg. (valves, couplings, pipe clamps, sleeves, etc.).

Bogota: Apartado Aereo 4083.

MCRAE, J. R.

Dist., Rockwell (regulators, valves, meters).

Barranquilla: Apartado Aereo 1020.

NARANJO, RESTREPO

Dist., Oakite Products (cleaning & descaling compounds).

Bogota: Carrera 10. No. 14-56. Apartado Aereo 6908. Carlos Restrepo, mgr.

NATIONAL CARBON COL.

Dist., Union Carbide (metal-cutting tools, chemicals, etc.).

Bogota

Cali

SOUTH AM. PETROLITE

Chemical demulsifiers, desalters, corrosion inhibitors, distillite treating, etc.).

Bogota: Banco de Bogota, Cr. 10. No. 14-33. Of. 1710. Box 7940. PETROLITE. William F. Faulkner, mgr.

VENEZUELAN EQUIPMENT

Dist., Dresser Industries-Security Inter'l. (valves, alloys, rock bits); Magnet Cove Barium (drilling muds & chemicals).

Bogota: Carrera 12. No. 11-64. Apartado Aerero 4178. Tel. 438316. SUPERSER. Frank Wright, mgr.

WILSON, JESSE

Dist., American Iron & Machine (packers & overshots).

Bogota: Calle 76. No. 12-29. Interior No. 3.

WORTHINGTON LTDA.

Heating, air conditioning, refrigeration, pumps, compressors, etc.

Bogota

OFICINA TECHNICA INDUS.

Dist., Yarnall-Waring (blowoff valves, water gages, liquid level indicators, expansion joints, steam traps, strainers).

Barranquilla: J. Ernest Van Gunten, Ing., mgr.

COSTA RICA

CHAMPION CO., LTDA.
Dist., GPE Controls-GP sub. (valves, controls, processing equipment, data-logging, automatic computing and control equipment).
San Jose: Apartado 2742. CHAMPION.

DISTRIBUIDORA, S. A.
Dist., Hercules Motors Corp. (Hercules & Hall-Scott gasoline and diesel engines, Lycoming gasoline engines).
San Jose: Apartado 1548. Fernando Palan C., mgr.

CONSTRUCTORA CO.
Dist., Insley (trench hoes, excavators, bucket carts); Rockwell regulators, valves, meters).
San Jose: Apartado 1867. Eric C. Murray, mgr.

COSTA RICA MACH.
Dist., DuPont (explosives).
San Jose: Apartado 1328. Calle A. Volio 337. Av. 3 Y 5.

SAUMELL, M. S., LTD.
Dist., DuPont (polychemicals, elastomers).
San Jose: Apartado 11, Calle 1, 18-S.

CUBA

ARMANDO J. VALDES & CIA
Dist., Oil Well Supply (oil field supplies); LeTourneau Westinghouse, (construction machinery); Bucyrus-Erie (drills, construction equipment).
Havana: Fabrica 13, Luyano, Apartado 824. AGASOCU.

CAMINONOS Y EQUIPOS MECANICOS, S. A.
Dist., Marmon-Herrington (Fords).
Havana: Via Blanca y Entronque, Carretera Guanabacoa. Box 124. EMSAC. Carlos E. Martinez, mgr.

CUBAN TRADING COMPANY
Dist., Amercoat Corp. (protective coatings, vinyls, epoxies, and Dimetcote).
Havana: Horter Building.

HUGO HARTENSTEIN
Dist., Manzel. Unit of Houdaille (force feed mechanical lubricators and chemical feeders).
Havana: Apartado 2049. Tel. 20-7214. HUGOHART. Hugo Hartenstein, mgr.

IBERIA MACHINERY CO., S. A.
Dist., Tulsa Winch (winches, power take-offs, speed reducers, transmissions).
Havana: Calzada de Rancho Boyeros, No. 1748.

IGNACIO DE ALMAGRO
Dist., Hercules Motors (Hercules & Hall-Scott gasoline & diesel engines, Lycoming gasoline engines).
Havana: Apartado 1005. Ave. Menocal 908.

MEXICO REFRACTORIES—CUBA
Refractory castables, ramming materials, mortars, firebrick.
HAVANA: Edificio Odontologico 1312. Calle L, No. 353. Tel. FO-4612. MEXREFCUBA. Armando Basarrate, mgr.

MINAGRO INDUSTRIAL, S. A.
Dist., Continental-Emsco (drilling and producing equipment); D. W. Onan and Sons (electric plants, generators, air-cooled engines).
Havana: Marinay Jovellar. Apartado. 475. Tel. U-1091-X 1398. MINAGRO. R. M. DeCastro, v.p. and gen. mgr.

MORA-ONA CO., S. A.
Dist., Armstrong Machine (traps and strainers).
Havana: San Nicolas 105. J. Mora-Ona, mgr.

OXIGENO HABANA, S.A.
Distributor, Modern Engineering (oxy-acetylene welding and cutting apparatus).
Havana: Box 2869.

SOLARES AND COMPANY
Dist., Marlow Pumps-Bell and Gossett Pumps; Rockwell (valves, meters, regulators).
Havana: 258 Concha St., Tel. 9-7563. FERSOLA. Alberta Solares, mgr.

TELEVISION Y AIRE ACONDICIONADA
Dist., Carrier Corp., (air conditioning, refrigeration, heating).
Havana: Apartado 210. Via Blanca 302. Tel. X-6581. REAIRE.

DISTRIBUIDORES ELECTRO INDUSTRIALES
Dist., D. W. Onan and Sons, (electric plants, generators, air-cooled engines).
Havana: Zulueta 617.

ANDERSON, W. M., TRADING CO.
Dist., DuPont Co. (explosives).
Havana: Apartado 1385.

CASA GILDEN
Dist., Aeroquip (hydraulic & aviation equipment).
Havana: Ayestaran 419.

CHICAGO BRIDGE & IRON
Oil storage tanks, evaporation saving equipment, refinery vessels, steel construction.
Havana: Ed. Abrey 402. Presidente Zayas 108. WILBRY. W. P. Bryant, mgr.

CUBAN AIR PROD. CORP.
Dist., Union Carbide (metal-cutting tools, alloys, etc.).
Havana

DUPONT INTER-AMERICA CHEM.
Polychemicals, photo products, finishes.
Havana: Ed. Ambar Motors. Calle 23. No. 55.

INDUSTRIAS CON. DE MATANZAS
Dist., Dresser-Industries-Security Int'l. (valves, alloys, rock bits); Magnet Cove Barium (drilling muds & chemicals).
Havana: Of. 452. Box 2876.

LADISH CO.
Pipe fittings.
Havana: Chacon 203. Box 2309. Tel. ML-1028. Lorenzo Palomares, mgr.

LIQUID CARBONIC CORP.
Dist., Beryllium (copper rod alloys, casting ingots).
Havana: Ayestaran 428.

OF. CONSULTORA EN INGENIERIA
Dist., Hills-McCanna (diaphragm valves, chemical, metering, porportioning pumps).
Havana: Manzana de Gomez 314.

OCHOA, GUILLERMO E.
Dist., Barton Instrument (twin bellow flow meter).
Havana: San Lazaro 16. Tel. A-4873.

PARKER, HOMER W. & CIA
Dist., Acme Protection Equipment (gas masks).
Havana: Amenidad 72, Cerro. Mailing address Apartado 3446. Tel. 70-6672. SALESCO. Homer W. Parker, mgr.

PENA, JOSE F.
Dist., National Supply (oilfield supplies).
Havana: Maquinaria Industrial. San Ignacio 104-108. Apt. 337. Tel. A-2475. JOSEPENA.

PROCON INTER'L.
Petroleum refinery, chemical & petrochemical installations.
Santiago de Cuba: Apartado 791. Jose A. Saco No. 6. C. B. Robbins, mgr.

PRODUCTOS ANILINAS AMER.
Dist., Oakite Products (cleaning & descaling compounds).
Havana: Ayestaran 307. Francisco Folgueira, mgr.

PRODUCTOS DE COBRE DE CUBA
Dist., Phelps Dodge Copper (wires & cable, pipe, tube).
Havana: Calle 23 No. 55. Dept. 222. Ed. Ambar Motors. Box 1745. Roberto Millar, mgr.

RODRIGUEZ, ARNESTO N.
Dist., Appleton Electric (electrical fittings lighting fixtures, cable reels, malleable iron plumbing fixtures).
Havana: 353 Zulusta St. Tel. M-5926-FO-5476. INTERSTATE. Arnesto N. Rodriguez, mgr.

SAMPLE, B. A.
Dist., Union Carbide (chemicals).
Havana

TURULL, THOMAS F. CIA
Dist., DuPont Co. (elastomers).
Havana: Apartado 2009.

WALLIS CHEMICAL CO.
Dist., DuPont Co. (chemicals).
Havana

FERRETERIA BANGO
Dist., D. W. Onan & Sons (electric plants, generators, air-cooled engines).
Camaguey: Republica 259.

CYPRUS

GENERAL ENGINEERING CO.
Dist., Hercules Motors Corp. (Hercules and Hall-Scott gasoline and diesel engines, Lycoming air cooled gasoline engines).
Nicosia: 8, Regina Street.

DENMARK

A/S CONSERVES TEKNIK
Dist., Amercoat Corp., (protective coatings, vinyls, epoxies, Dimetcote).
Copenhagan: Ny Kongensgade 15.

DEFORENEDE AUTOMOBILFABRIKER A/S
Dist., Hercules Motors Corp., (Hercules and Hall Scott gasoline and diesel engines, Lycoming gasoline engines).
Odense: Mr. Christensen, mgr.

SOPHUS BERENDSEN A/S
Dist., Shand & Jurs — GP sub., (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, data-logging).
Copenhagen: Orstedhus. 41 Vester Farimagsgade. Tel. Central 8500. BERENDSEN.

AKTIESELSKABET NORDISK VENDITOR
Dist., Chiksan Export (swing joints, steel rotary hoses, circulating heads, mud guns, etc.).
Copenhagen: 14 Tordenskjoldsgade. Tel. Byen 9825. VENDITOR. E. Bjerg Mortensen. VENDITOR.

AMERKANSK FOTOMATERIEL
Dist., DuPont Co. (photo products).
Copenhagen: Vimmelskaftet 42 A.

CHRISTENSEN, V. M.
Dist., Beryllium (copper rod alloys, castings, ingots).
Copenhagen: 20 Bulowsvej.

ENGELHARD INDUSTRIES
Petroleum catalysts.
Copenhagen: Vimmelskaftet 42 (Jorcks Passage).

HASSENKAMM, KARL, & SON
Dist., Roots-Connersville Blower-Dresser Industries (blowers, meters, vacuum pumps).
Copenhagen: Nr. Farimagsgade 63.

KRAGH—MULLER & ANDERSEN
Dist., Barton Instrument (twin bellow flow meters).
Copenhagen: Andersens Blvd. 4.

ELOF HANSSON
Dist., DuPont (petroleum chemicals).
Copenhagen: 19 G. L. Kongevej.

ECUADOR

FERROSTAL DEL ECUADOR, SA
Dist. for George F. Failing, (drilling rigs).
Guayaquil: Casilla 853, Fco. De P. Ycaza 430.

SOCIDAD INDUSTRIAL Y COMMERCIAL CA
Dist., Continental-Emsco, (drilling and producing equipment); American Iron & Machine (packers & overshots).
Guayaquil: Casilla Correos 972. Tel. 14391. SICO. Guillermo Ramos, rep.
Quito: Box 2192.

AGRICOLA, S.A.
Dist., DuPont Co. (petroleum chemicals, explosives, polychemicals, elastomers).
Quito: Box 45.

AGRO-QUIMICA INDUSTRIAL
Dist., DuPont Co. (photo products, polychemicals, elastomers, explosives.)
Guayaquil: Box 926.

LAVELLE, L.A.
Dist., DuPont Co. (finishes).
Quito: Apartado de Corro 283. Calle Bolivar 256.

SCIPPA, MARIO A.
Dist., W. H. Curtin (lab apparatus, petroleum testing equipment, reagent chemicals).
Guayaquil: Casilla 5678.

SMITH, HAROLD T. INC.
Dist., Dresser Mfg. (couplings, pipe clamps, sleeves, etc.).
Quito: Box 630.

SOCIEDAD INTERN'L. DE COM.
Dist., DuPont Co. (finishes).
Guayaquil: Apartado 374.

EGYPT

ANGLO EGYPTIAN MOTORS CY
Dist., Marmon-Herrington, (Fords).
Cairo: 27 Adly Pasha. NEMESIS. D. H. Birch, mgr.

ARAB CONTRACTING & TRADING
Dist., Oil Well Supply (oilfield supplies) Bowen Itco. Inc. (fishing tools, rotary jars, wire line pressure control).
Cairo: 42 Sherif Pasha St. Box 1837 ARABCAT. Tel 56409.

EGYPTIAN TECHNICAL BUREAU
Dist., George F. Failing (drilling rigs).
Cairo: Immobilia Building Flat 113.

EL ALAMIA TRADING & INDUSTRIAL CO.
Dist., Hercules Motors Corp., (Hercules and Hall-Scott gasoline engines, Lycoming gasoline engines).
Cairo: 18, Soliman Pasha St. Elie Ph. Kfoury, mgr. dir.

ALEXANDRIA CHEMICAL AGENCY
Dist., Oakite (cleaning & descaling compounds).
Alexandria: 1 Rue de L'Eglise Debbane. D. Adda, mgr.

ALHADISSA TRADING CO.
Dist., Aeroquip. (hydraulic & aviation equipment).
Cairo: 31 Emad El Dine St.

ELECTRO MOTORS
General Engineering & Electrical Co.
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Cairo: 33 Orabi St. (Ex. Tewfik).

H. E. AHMED PASHA ABBOUD
Dist., Clark Bros.-Dresser Industries (compressors, engines, gas turbines).
Cairo: 26 Shariah Sherif Pasha.

NORTHEAST AFRICA TRADING CO.
Dist., DuPont Co. (finishes).
Cairo: 43 Rue Kasr El Nil.

ETHIOPIA

JAMES G. HOLWERDA
Dist., Ralph M. Parsons (engineering-construction.
Asmara, Eritrea: % Ralph M. Parsons Company, Box 862. Tel. 6124 and 2121. PARSETH. James G. Holwerda, mgr.

ORILEX (ETHIOPIA) LTD.
Dist., Columbian Steel Tank, (storage tanks and truck tanks).
Addis Ababa: Sabean Bldg. F. M. Smuts Ave. Box 795. Tel. 7441-7412. ORILEX. S. F. Cox, mgr.

H. V. STRANGER-FORD & CO., LTD
Dist., Marmon-Herrington, (Fords).
Asmara: 14 Via Sapeta St. Box 837. ASMARA. H. V. Stranger-Ford, mgr.

FINLAND

OY CONTROL AB
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Helsinki: Eerikinkatu 24.

RIXTEX OY
Dist., Amercoat Corp., (protective coatings, vinyls, epoxies, Dimetcote).
Helsinki: Tehtaankatu 4.

AURAMO, INS. TSO H.
Dist., Aeroquip (aviation & hydraulic equipment).
Helsinki: Fabianinkatu 13.

O. Y. AF FORSELLES A.B.
Dist., Curtis Wright (alloy steel pressure pipe).
Helsinki: Alexandersgaten 19. Vaihde 61 966. FORSELLESCOMP. Stig-Eric Paltschik, mgr.

O.Y. TEKNOLUX A.B.
Dist., Roots-Connersville Blower-Dresser (blowers, meters, vacuum pumps).
Helsinki: Mannerheimvagen 18.

FORMOSA

SHING SHENE & CO.
Dist., George F. Failing, (drilling rigs).
Taipei: Box 96.

UNION ENGINEERING CO.
Dist., Continental-Emsco, (drilling and producing equipment).
Taipei: 16, Alley 9 Lane 1274, Chung Cheng Rd. Box 1031. Shao I Ho., mgr. Tel. 22847.

FRANCE

AHMET NEYZI
Dist., Ralph M. Parsons, (engineering-construction).
Paris: 41 Av. George V. Tel. Balzac 9-560. PARNEY. Ahmet Neyzi, mgr.

CAMERON IRON WORKS, FRANCE
Blowout preventers, Xmas trees, valves & instruments.
Paris: No. 9 Ave. F. D. Roosevelt. Tel. Balzac 92-30. CAMIRON. E. E. Parker, mgr.

CHRISTENSEN DIAMOND PROD.
Diamond coring and drilling equipment.
Seine: 62-64 Blvd. Galliene. Tel. Plaine 35-40. CHRISDIACOF. R. E. Lawe, mgr.

COMPAGNIE INDUSTRIELLE CO.
Dist., Olin Cuno Filter Corp., (industrial filters).
Paris: 76 Blvd.-Victor Hugo. E. C. Collins, Mgr. OLCUNO.

COSNE-SUR-LOIRE (NIEVRE)
Dist., Drilco Oil Tools, (drill collars, subs, drill collar stabilizers, rotary field inspection unit for drill collars).
Paris: Boite Postale 19. Andre Cendre, mgr.

EXPLOR. GEOPHYSIQUE ROGERS
Geophysical contractor.
Paris: 34, Avenue des Champs-Elysees. Tel. Balzac 6960. ROGEXCO. Pierre Maugis, mgr.

FORAP
Dist., Oil Well Supply, (oilfield supplies).
Paris: 85 Avenue Paul Doumer.

R. FRENKEL
Dist., Ebasco Services, Inc., (engineering, construction and business consulting services).
Paris: 1 Ave. Hoche. R. Frenkel, mgr.

HINDLE-HAMER FRANCAISE
Dist., Hamer Valves, Inc., (lubricated pump valves, slush valve seats, lined blinds, pump liner sleeves, flanges).
Paris: 6, Avenue Franklin Roosevelt. Tel. Balzac 66-70. PETROSOC. Roger Henquet, mgr.

S.E.M. HISPANO-SUIZA
Dist., Hercules Motors Corp., (Hercules gasoline & diesel engines, Lycoming gasoline engines).
Bois-Colombes: Rue Du Capitaine Guynemer. Maurice Heurteux, mgr.

HOMCO INTERNATIONAL, C. A.
Oilwell fishing tools, directional drilling, oil field supplies.
Paris: 62 Quai des Orfevres. Tel. Maillot 6745. Bertrand Negre, mgr.

COMPAGNIE FRANCAISE DES PROCEDES HOUDRY
Houdry processes.
Paris: 104, Blvd. Haussmann. Tel. Europe 37-77. Jean C. Thorel, mgr.

LE MATERIEL DE SONDAGE
Dist., Well Instrument Develop Co., (electric well logging equipment).
Paris: 71, Ave. des Champs Elysees. Tel. Balzac 77-24. MATERSONDA. M. Petit, mgr.

LINDQVIST ET CIE
Dist., George F. Failing, (drilling rigs).
Paris: 32, Ave. de l'Opera.

QUAKER OATS (FRANCE)
Furfural.
Paris: 3 Rue Pillett-Will. Tel. Provence 91-16. KWAKER. R. A. Chretien, mgr.

SAPHYMO
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Paris: 9 Place des Etats-Unis.

SEPI
Dist., Shand & Jurs, — GP-sub., (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment); Selas (tubular furnaces for continuous processing, burners, dehydrators); Barton Instrument (twin bellow flow meters).
Paris: 4 Rue de Londres. Tel. C.C.P. Paris 13.551.29.

SIKA PRODUCTS ET TRAVAUX
Dist., Carboline Co., (protective coatings).
Paris: 164 Rue de Foubourg. Tel. 51. Honore. Paul Boyrie, mgr.

SOCIETE AERIENNE DE RECHERCHES MINIERES
Dist., Aero Service Corp., (airborne geophysical surveys).
Neuilly-sur-Seine: 52 Avenue de Neuilly. Tel. SAB 9453, 9454, 9818. SARMAVION. Richard Crosby, mgr.

SOCIETE ANONYME HEURTEY
Dist., Petro-Chem Devel., (service for fluid refinery and chemical plant heaters).
Paris: 38 Av. Georges Mandel XVI°. Box Boite Postale 18-16. Kleber 48-00 & 16-20. GAZHEURTEY. Paul Heurtey, mgr.

SOREG.
Dist., GPE controls — GP sub. (valves,

controls processing equipment, data-logging automatic computing & control equipment). Southwest Indus. Electronic-Dresser (seismograph equipment).
Paris: 48, Rue Pernety. ASKAREG.

STONE AND WEBSTER ENG.
Chemical and petrochemical plants, power station and industrial plants.
Paris: 34 Ave. des Champs Elysees. Tel. Belzac 74-20. STOWEBENG. P. Devoluy, mgr.

TROUVAY & CAUVIN
Dist., Armstrong Mac. Wks. (traps).
Paris: 783 rue Ordener, 18e. UNION-AFRIC.

UNION INDUSTRIELLE AFRICAINE
Dist., Continental-Emsco, (drilling and producing equipment).
Paris: 7, Ave. George V. Tel. Balzac 49-17. Rene Clipet, mgr.

SOCIETE SEPIA
Dist., Amercoat, (protective coatings, vinyls, epoxies, Dimetcote).
Paris: 7 rue Gounod.

APPAREILLAGES SPEC. POUR EQUIP. IND.
Dist., Vapor Recovery Systems (equip. related to storage & transportation of liquids).
Norgent-Sur-Marne: 1 A 5 Ave. Kelber. Tel. TRE 44-90. Georges Reblin, mgr. ROBAS.

ARMCO
Dist., National Supply (oilfield supplies).
Paris: 57 Rue Ampere. INGOIRON. Tel. WAGRAM 68-20.

BATIGNOLLES-CHATILLON
Dist., Pacific Pumps (pumps); Ideco-Dresser Industries (drilling rigs, drilling & producing equipment).
Paris: 5 Rue de Monttessuy. Tel. Solferino 90-00. BATICHATIL. J. L. Delpech, gen. mgr.

BRIDGES, W. A.
Dist., Thompson-Ramo-Wooldridge (digital control computer, systems engineering).
Paris: 7 Ave. George V. Tel. Balzac 68-56.

CARDWELL MFG.
Rigs, trenches, hoists, masts, drawworks.
Paris: 1 Rue de Chateaudum. Tel. Lamartine 47-40. DUCOTRA. Srecko Katfez, mgr.

COMPAGNIE DE FREINS ET SIGNAUX WESTINGHOUSE
Pneumatic controls for oil industry & hydraulic surge dampening.
Paris: 18 Rue Volney. Maurice Loiseau, mgr.

COMPAGNIE DES MEULS NORTON
Dist., Norton Behr-Manning (porous mediums, catalyst carriers, bricks, cements).
Paris: 13-17 Rue Salneuve.

COMPAGNIE JOY S.A.
Dist., Baash Ross (drilling & producing equipment).
Paris: 30 Rue de Chabrol. SULLIMACO. J. Guibout, mgr.

CO. TECHNIQUE DES PETROLES.
Dist., M. H. Detrick (engineered arches & walls for heat enclosures.
Paris: 1 Rue Jules Lefebvre. Tel. TRInite 49-95. CETEPE. Yves Letort, mgr.

COMPAGNIE TRANSCONTINENTALE
Dist., Cardwell (rigs, trenches, hoists, masts, drawworks).
Paris: 1 Rue de Chateaudun. Tel. LAMAartine 47-40.

CONSTRUCTIONS METALLIGUES DE PROVENCE
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Paris: 174 Blvd. Haussmann. METAPROVENCE.

CONTROLE BAILEY
Dist., Jerguson Gage & Valve (remote reading liquid level gages).
Paris: 32 Blvd. Henri IV. TURBIGO 35-78. Jean Theis, mgr.

ENTREPRISES A. COCHERY
Dist., Gulf States Asphalt Co. (canal & reservoir linings).
Paris: 6 Rue de Rome. Tel. EUrope 60-84. Henri Jacques, mgr.

ENGLEHARD INDUSTRIES
Petroleum catalysts.
Paris: 48, Ave. Victor-Hugo.

HALLIKAINEN INSTRUMENTS
Industrial & scientific instruments.
Paris: 4 Rue de Loudres. Box 9. TEQUIP. F. Peyroun, mgr.

LUCEAT, S.A.
Dist. Chiksan Export (swing joints, steel rotary hoses, circulating heads, mud guns, etc.).
Paris: 37 Boulevard Malesherbes. Tel. Anjou 99-94 & 99-95. LUCEATELEC. M. Charbonnel, pres. gen. mgr.

MAGNETROL PETROCHIMIE
Dist. Magnatrole (liquid level controls, boiler water level controllers, flow alarm switches).
Paris: 77 Rue De La Boetia. Tel. GAL 99-16. Rene Berg, mgr.

S. N. MAREP
Dist. Shaffer Tool, (blowout preventers, flow beans, casing heads, swabs, jars, drilling equipment).
Paris: 12/16 Rue Jean Nicot. Box 5-07. Tel. SOLferino 89.89. MAREPETROL. F. E. Emmanuelli, mgr.

MATERIAL PETROLIER
Dist. Web Wilson Tools (drilling tools).
Paris: 5 Rue d/Artois. Louis W. F. Lacroix, mgr.

PETRO-FOUGA
Dist. Brown Fintube Co. (fintubes, heat exchangers, tank suction heaters, line heaters, hairpin sections, fuel oil heaters, etc.).
Paris: 111 Ave. Victor-Hugo. Tel. KLEber 96-44. PETROFOUGA. Francois Lehideux, mgr.

PETROLE SERVICE
Dist. Jerguson Gage & Valve (liquid level gages).
Paris: 32 Rue de Loudres. Tel TRInite 94-70. SERVOIL. M. L. Vignes, mgr.

PREMAFRANCE — PETROCHIMIE
Dist. T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).
Paris: 77 Rue de la Boetie. PETROPREMA. Guntars Abols, mgr. Tel. EL-61-94.

SCHLUMBERGER OVERSEAS S.A.
Electrical logging & gun perforating.
Paris: 42 Rue St. Domingue. Proselec. Jean Riboud, pres., Guy Baboin, VP, operations.

SOCIETE D'ETUDES PETROLIERES
Dist. Chiksan Export (swing joints, steel rotary hoses, circulating heads, mud guns, etc.).
Paris: 6 Ave. Franklin Roosevelt. BALzac 66-70. PETROSOC.

SOCIETE FRANCOISE DES TECHNIQUES LUMMUS
Dist., Lummus Co., (refinery plants).
Paris: 11 Blvd. de Sebastropol. J. B. Mueller, mgr.

SOCIETE KELLOGG
Engineering procurement, construction of refineries.
Paris: 28 Rue Bayard. Tel. BALzac 21-89. KELLOGG. J. M. Sexton, mgr.

R. S. STOKVIS & FILS
Dist. Bronson Inst. (ultrasonic gaging & cleaning equipment, flaw detectors).
Paris: 2-22 Rue des Petits-Hotels. STOKVIS.

TOCALEMIT S.A.
Dist. Aeroquip (aviation & hydraulic equipment).
Paris: Boite Postale No. 11.

YOUNG, W. R.
Dist. National Supply Co. (oilfield equipment).
Paris: 57 Rue Ampere. c/o Armco. Tel. WAGram 68-20. INGOTIRONI.

SEPPIC
Dist. DuPont Co. (photo products, petroleum chemicals, polychemicals).
Paris: 70 Ave. Des Champs-Elysees.

ETS. JEAN LAGARRIGUE ET
Dist. DuPont Co. (finishes).
Paris: 14 Rue Lincoln.

SIFTA
Dist. Mack (trucks).
Paris: 47 Rue de Monceau. MACK-SIFTA.

SOCIETE FRANCAISE DES INDUSTRIES DRESSER
Dist. Clark Bros., (compressor engines, gas turbines).
Paris: 11 Rue Auber.

ETS. J. COUTHON-BRUNNER & MARCHAND
Dist. Bucyrus-Erie (drills, construction equipment).
Paris:

AUDCO — FRANCE, S.A.
Dist. Rockwell (meters, regulators, valves).
Paris: 53 Rue Mathurin-Regnier.

L'AIR LIQUIDE S.A.
Dist. Union Carbide, (welding & cutting equipment).
Paris

METAUX INOXYDABLES OUVRES
Dist. Union Carbide (heat & corrosion-resistant alloys).
Paris:

SOCIETE GRAHAM
Dist. Union Carbide (chemicals).
Paris:

GEN. GEOPHYSICAL DE FRANCE
Geophysical contracting.
Paris: 4 Square Rapp. Tel. FONtenoy 6703. GENGEOCO. Charles B. Cox, mgr.

SFIDSA
Dist., Ideco-Dresser (drilling rigs).
Paris: 11 Rue Anber. Tel. AN 96-7. DRESSERPAR. R. A. Chesneaux, pres. and gen. mgr.

ESTAB. CHPOLANSKY
Dist., Dewrance & Co., (steam traps, strainers).
Paris: 37 Ave. Franklin D. Roosevelt.

GERMANY

ATLAS DEUTSCH AMERIKANISCHE OLFELDDIENST
Dist., Perforating Guns Atlas, (wire line services — logging, perforating).
Kiel: Rankestrasse 1. Dr. Hans Nielsen, mgr.

BODENSEEWERK PERKIN-ELMER
Infrared spectrophotometers, vapor fractometers.
Ueberlingen-See: Tel. 716. BODENSEEWERK. Kurt Wilde, dir.

DEUTSCHE COMMERZ
Dist., Houdry Process, (processes).
Frankfurt: Bockenheimer Landstrasse 106. Tel. 773054. COMMERZ G. Frank-Fahle, mgr.

DEUTSCHE NALCO-CHEMIE
Dist., National Aluminate, (chemicals for treatment of industrial waters and petroleum. Herbicides, corrosion inhibitors, and coagulants).
Frankfurt: Schillerstrasse 31, Ecke Tau-

benstrasse 1. Tel. 27633. NALCOCHEMIE. A Cantalini, mgr.

EASTMAN INTERNATIONAL CO.
Dist., Eastman Oil Well Survey, (directional drilling, oil well surveys, star recorders, well logging service); Ideco — Dresser Industries (drilling rigs, drilling & production equipment); Shaffer Tool (blowout preventers, flow beans, casinp heads, high pressure drilling equipment, etc.).
Hannover: Hildescheimer Str. 34. Tel. 8-4715. EASTCO. Erich Krebs, mgr.

FAGRO
Dist., Lane Wells, (oil field services, perforating, well logging, packers); George F. Failing (drilling rigs.); Baker Oil Tools, (sales & mfg. representative); Chiksan Export (swing joints, steel rotary hose, circulating heads, mud guns, etc.); Martin Decker (indicating & recording drilling control instruments); National Supply (oilfield supplies); Web Wilson (drilling tools); Shaffer (blowout preventers, flow beans, casing heads, high pressure drilling equipment, etc.).
Hannover: Osterstrasse 83/84. FAGRO. Tel. 21851-53.

HERMAN VON RAUTENKRANZ
Dist., Oil Well Supply, (oilfield supplies). Lebus International Engineering (grooving and controlled counterbalance wire line spooling systems).
Celle (Hann): Box 114.

CARL F. LUBCKE
Dist., Shand and Jurs, (safety equip. for storage tanks, automatic level gages and indicators, data-logging, remote control equipment).
Hamburg: Colonnaden 70. Tel. 35 52 02. DRAHTLUBCKE. Carl F. Lubcke, mgr.

PETROCHEM G.M.B.H.
Dist., Petro-Chem Develop., (engineering service for fluid refinery and chemical plant heaters).
Dusseldorf: Tiergartenstrasse 45. Tel. 686635/6. PETROCHEM. G. Murmann, mgr.

PEUTE-CHEMIE
Dist., Oil Base, Inc., (field engineering service).
Hamburg: Georgeswerder Damm 1-2. Tel. 78 75 22/78 68 63. PEUTE-CHEMIE. Horst Barthel, mgr.

CHRISTIAN DIAMOND PROD.
Diamond coring and drilling equipment.
Celle: Braunschweiger Heerstrasse 61. Tel. 5951-2.

HEINRICH HABERMANN SCHIFFS- UND MASHINEN REPARATUR
Dist., Carrier Corp., (air conditioning, refrigeration, heating).
Hamburg: Kamerunweg, 7. Tel. 38 62 75 u. 38 67 54. HASCHIMA.

HEINRICH THULESIUS
Dist., Armstrong Machine Works, (traps).
Bremen: Duckwitzstrasse.

N.V. NEDERLANDSCHE AIR CONDITIONING MIJ. GEBR. VAN SWAAY
Dist., Carrier Corp, (air conditioning, refrigeration, heating).
Hamburg: Zweigburo Hamburg. An der Alster 33. NEDAIRCO.

OSWALD E. BOLL
Distributor for Amercoat, (protective coatings, vinyls, epoxies, and Dimetcote).
Hamburg: Georgeswerderdamn 1.

W. STRIKEFELDT & CO.
Dist., Bucyrus-Erie (drilling rigs, construction machinery).
Rheinland

BRENNTAG G.m.b.H.
Dist., Union Carbide (chemicals, molecular sieves).
Muelheim/Ruhr

KNAPSACK GRIESHEIM A.M. WERK GRIESHEIM-AUTOGEN.
Dist., Union Carbide (welding and cutting equipment).
Frankfurt

LAUERMANN & CO.
Dist., Southwestern Ind. Electronics — Dresser Industries (seismograph equipment).
Hanover: Goethestrasse 9

DEUTSCHE AUDCO ROCKWELL
Dist., Rockwell (meters, regulators, valves).
Bielefeld: Niederwall 9

NORDMANN, RASSMANN & CO.
Dist., DuPont Co. (polychemicals, elastomers).
Hamburg: Kajen 2.

H. COSTENOBLE
Dist., DuPont Co. (petrochemicals, photo products).
Frankfurt: Guiollettstr 47.

BERGER, JULIUS
Dist., Aeroquip. (hydraulic and aviation equipment).
Baden: (17b) Sasbach bei Achem.

PETERS, CLAUDIUS
Dist., M. H. Detrick (engineered arches and walls for all types heat enclosures).
Hamburg: Klosterwall 2. Postfach 790. Tel. 33-93-41. John W. Grapengiesser, mgr. FULLERPETERS.

CONSOLIDATED ELECTRODYNAMICS
Analytical instruments.
Frankfurt: Weissfrauenstrasse 3. CONSOLENG. Tel. 27123. Albert W. Brandmaier, mgr.

COSTENOBLE H.
Dist., Petrolite (Tretolite chemical demulsifiers, desalters, corrosion inhibitors, paraffin removers, water-flood additives, electric desalting, etc.).
Frankfort: Guiollettstrasse 47. Tel. 723634.

DEUTSCHE NORTON GESELLSCHAFT
Dist., Norton Behr-Manning (porous mediums, catalyst carriers, bricks, cements).
Cologne: Wesseling bez.

DEUTSCHE WORTHINGTON
Air conditioning, refrigeration, heating, pumps, etc.
Hamburg

DOTT OLIVER G.m.b.H
D-gassers, Clayjectors, D-sanders.
Wiesbaden: Gustav-Freytag-Strausse 9. Tel. 20091 and 29420. Teletype: 0416/756. DORROLIVER. W. Gundelach, mgr.

EDECO GERMANY, GmbH
Dist., Security Inter'l. — Dresser Industries (valves, alloys, rock bits).
Hamburg: Fontenay 1-A.

FRIEDRICH UHDE
Dist., Brown Fintube Co. (heat exchangers).
Dortmund: Deggingstrasse 12. Hans Uhde, mgr.

GENERAL CONTROLS
Automatic control valves, solenoid valves and automatic controls.
Dusseldorf: 22 Brombergerstrasse. Tel. 71417. Rolf K. Hutter, mgr.

GETEHOFFNUNGSHUTTE & AKTRENGESEKLSCHAFT
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Oberhausen-Sterkrade: Werk Sterkrade. HOFFNUNGSHUTTE.

ERNEST KIRCHNER
Dist., Selas Corp. (tubular furnaces for continuous processing, burners, dehydrators).
Hamburg: Postfach 706. Tel. 86 49 54/55. FEUROKIRCHNER.

PREMATECHNIK, GmbH
Dist., T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).
Frankfurt: Rathenau Platz 2. Tel. 21875. PREMATECHNIK. Otto Spiecker, mgr.

RUHRPUMPEN GmbH
Dist., Pacific Pumps — Dresser Industries (pumps).
Witten: Stockumer Strasse 10—Annen.

SCHNABEL, Dr. E. & Co.
Dist., Resistoflex (teflon hose, fittings, and hose assemblies, piping, components, molded bellows.
Limburg-Lahn: Offheimer Weg. Tel. 2487. SCHNABEL.

SZEPANEK, J. F.
Dist., Baker Oil Tools, (technical representative).
Celle: 12a Hermann Billungweg. Tel. 5849.

SHOPPE & FRAESER, GmbH
Dist., Barton Instr. (twin bellow flow meter); Librascope, Inc. (Computing, measuring, and control devices).
Minden/Westfalen: Schillerstr. 72. Fernrufsammelnur. Tel. 3631.

WESTINGHOUSE BREMSEN GESELLSCHAFT
Pneumatic controls, hydraulic surge dampening.
Hannover: 21 Am Lindener Hafen. Postfach 451. W. Gnade, mgr.

WILKE-WERKE
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Braunschweig: Postfach 92. WILKE-WERKE.

WINDGASSEN, EMIL
Dist., Beryllium (copper rod alloys and casting ingots).
Wuppertal, Ronsdorf

GREECE

GEORGE FRANGISTAS
Dist., George F. Failing, (drilling rigs).
Athens: 65 Patission.

HELLAS-AMERICA, INC.
Dist., Hercules Motors Corp., (Hercules gasoline & diesel engines, Lycoming gasoline engines).
Athens: No. 126 Syngrou Ave. Pan. Ch. Arghiropoulos.

PANOS S. SAVIDES, S.A.
Dist., Continental-Emsco, (drilling and producing equipment).
Athens: 1 Blvd. Alexandras. Tel. 612-715. PASAVID.

DEMETRIUS C. TZITZINIAS
Dist., Amercoat, (protective coatings, vinyls, epoxies, Dimetcote).
Athens: 9 Valaoritou St. Tel. 617-657.

SARACAKIS & CALOMIROS
Dist., DuPont Co. (finishes); Insley (trench hoes, excavators, cranes).
Salonika: 60 Megalou Alexandrou st.
Athens: 43 Third Septembriov St.

VERNICHROME, S.A.
Dist., DuPont Co. (finishes).
Athens: 43 Third Septembriou St.

C. G. LAZARAKIS
Dist., DuPont Co. (elastomers)
Athens: Aristides St. 1

PROODOS CO.
Dist., Insley (trench hoes, excavators, cranes).
Athens: 29 Chalcocondili St.

ANGELOPOULOS, L & KOUTROUFIOTIS, N.
Dist., Curtis-Wright (alloy steel pressure pipe).
Athens: 3 Athinas St. Tel 28-224. LANGELO. L. Angelopoulos, mgr.

CATOPODIS TRIANTAPHYLLAS & CO.
Dist. Aeroquip, (hydraulic and aviation equipment).

Athens: Capodistriow St, 27
DIMITRACUPOULOS
Dist., Aeroquip (hydraulic and aviation equipment).
Athens: Box 426.
JOANNIDES, ALEX B.
Dist., W. H. Curtain (lab apparatus, petroleum testing equipment, reagent chemicals).
Athens: 35 Tritis Septembriou St.
N. PRINOS & P. STRAVRIDIS
Dist., Beryllium (copper rod alloys and casting ingots).
Athens: 3 C. Paleologou St. (Platia Vathy).

GUATEMALA

C. FAJARDO ARCEYUZ
Dist., Columbian Steel Tank, (storage tanks, truck tanks).
Guatemala City: 7a Avenida Numero 14-41, Zona 1. Apartdo 426. Tel. 5075. FAJARCECO. Carlos R. Fajardo, mgr.
DISTRIBUIDORA KEPACO
Dist., Black, Sivalls & Bryson, (oil field equipment).
Guatemala City: 9a Ave. No. 20-06, Zone 1.
FISHER Y CIA LTDA.
Dist., Marmon-Herrington, (Fords).
Guatemala City: 7a Ave. 2-34, Zone 4. FISFA. Roberto Fisher, mgr.
J. P. MARTIN
Dist., Jet Lube, (thread compounds for drill collars, tool joints, casing, tubing, oilfield grease specialties.) Garrett Oil Tools, (gas lift equipment, motor valves and controllers, lease automation equipment, safety valves). Baker Oil Tools (technical advice); Magnet Cove — Dresser Industries (drilling mud and chemicals).
Guatemala City: 6th Ave. No. 12-21. Box 1351.
FELIX MONTES & CIA, LTDA.
Dist., George F. Failing, (drilling rigs).
Guatemala City: Sa Calle 3-27.
EMILIO VILLACORTA M.
Dist., DuPont Co. (polychemicals, elastomers).
Guatemala City: 9A Calle No. 3-55. Zona 1.
CHARLES W. QUALMAN. SUCS.
(Jorge R. Cordero & Cia).
Dist., DuPont Co. (photo products, finishes).
Guatemala City: 12 Calle Oriente No. 6-30.
A. LAMPORT & CO. SUCS.
Dist., DuPont Co. (explosives).
Guatemala City: Apartado 165.
MAEGLI, JUAN U. & CIA.
Dist. Security Inter'l. — Dresser Industries (valves, alloys, rock bits).
Guatemala City: 7A Ave. 3-42. Zona 4.
HIDRO-ELECTRICAS DEL ATLANTICO
Dist., Web Wilson (drilling tools).
Guatemala City: 20 Calle Oriente 7-19. Rafael Ayau, mgr.

INDIA

ASSOCIATED EXPORTS IMPORTS
Dist., William W. Nugent & Co., (oil filters, lubricating systems for pipe lines); Aeroquip (hydraulic aviation equipment).
Calcutta: 8-B, Lall Bazar St.
FEDERAL INDIA TRADING CO.
Dist., Shand and Jurs — GP — sub. (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment. data-logging). GPE Controls, (valves, controls, processing equip., data logging, etc.)
Ahmedabad: Box 61. GRAPHODES.
GEOPHYSICAL SERVICE INTER'L.
Seismic, gravity, and magnetic surveys and seismic data processing services.
Calcutta: 19/1 Camac St. E. J. Malovich, supvsr.
LARSEN & TOUBRO
Dist., George F. Failing, (drilling rigs).
Bombay: P. O. Box 278.
R. N. MOOKERJEE & CO.
Dist., Modern Engineering, (oxy-acetylene welding and cutting apparatus and supplies).
Calcutta: 12 Raja Woodmut St.
GANNON DUNKERLEY & CO.
Dist., Insley trench hoes, excavators, cranes).
Calcutta: Box 2392.
UNITED PROVINCES COMMERCIAL
Dist., Insley (trench hoes, excavators, cranes).
Calcutta: 2491.
KHANNA, B. K. & CO.
Dist., Ideco — Dresser Industries (drilling rigs, drilling and production equipment); Clark Bros. (compressors, engines, gas turbines).
New Delhi: 14 F. Connaught Place, Centre Circle. Tel. DIRectors 44978. KAYMOBILE.
UNION COMMERCIAL & IND.
Dist., DuPont Co. (polychemicals, elastomers).
Bombay: Box 1445.
AMA, LTD.
Dist., DuPont Co. (photo products).
Bombay: Canada Bldg. Hornby Rd. Box 556.
AMIN CHAND PAYARE LAL
Dist., Dresser Manufacturing (pipe couplings and fittings).
Calcutta: 21A Canning St.
GREAVES COTTON & CO.
Dist., Bucyrus-Erie (drilling rigs, construction machinery).
Calcutta
Bombay
New Delhi
KILBURN & CO., LTD.
Dist., Dewrance & Co., (steam traps & strainers).
Calcutta: Box 61.

INDONESIA

BIRO INSINJUR KIMIA INDONESIA
Dist., Infilco Inc., (industrial filters).
Bandung: Djl. Hassanudin 24. BIKI. Ir. Lie Tiong Djien, mgr.
CLAYTON H. BOWER
Dist., Jet Lube, (thread compounds for drill collars, tool joints, casing and tubing, oilfield grease specialties).
Djakarta: Blok K/2, No. 21. Kebajoran Boru.
N. V. INTERN, 'L. CREDIET-EN HANDELS
Dist., DuPont (finishes).
Socrabaia, Java: Handels Vereeniging 'Rotterdam'.
Medan, Sumatra:
Makassar, Celebes:
Djakarta:
Bandoeng, Java:

IRAQ

CONTRACTING & TRADING
Dist., Bowen Itco, (fishing tools, rotary jars, wire line pressure control).
Baghdad: Minas Bldg., South Gate, Box 181, Tel. 86128-9. CAT.
Basrah: Box 29, Ashar. Tel. 3551-2670.CAT.
Kirkuk: Box 2269. Tel. 2093. CAT.
DEVELOPMENT SERVICES CO.
Dist., Infilco Inc., (industrial filters).
Baghdad: South Gate, Tel. 88125. EURASIAN. D. A. Tobgian, mang. dir.
IRAQI AUTOCAR CO., LTD.
Dist., Marmon-Herrington, (Fords).
Baghdad: Roxy Bldg. Rashid St. CONFIDENCE. Maurice M. Khalastchi, dir.
IBRAHIM J. SAAD & FILS
Dist., Rust-Oleum (rust preventive, protective coatings for rigs, tanks, equipment, metal surfaces).
Baghdad: Rashid St. Tel. 7488, 89781-4. SAAD.
KETTANEH, F. A. & CO.
Dist., DuPont Co. (finishes, elastomers).
Baghdad: Al Rashid St.

IRAN

ENG. Z. AFSHAR
Dist., Metallizing Engineering (metallizing equipment, wires).
Teheran: Amir-Abad, Nosrat Ave. Z. Afshar, mgr.
D. C. VAN DINE
Dist., Ralph M. Parson Co., (engineering-construction).
Teheran: Pan American Airways Bldg. Ave. Hafz. Tel. 69361. PARSONS. D. C. Van Dine, mgr.
IRANIAN AERO SERVICE JOINT STOCK CO.
Dist., Aero Service, (airborne geophysical surveys, aerial photography, photo and topo maps).
Teheran: 33 Khochbakhti Ave. AERCORP. David Copland, mgr.
KALAE SWEDE CO., LTD.
Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Teheran: Box 1538.
MESA CO., LTD.
Dist., Infilco Inc., (industrial filters).
Teheran: 5 Ave. Churchill. Tel. 44286. 222. Enoch Lachinian, adm. dir., S. Acopian, chief eng.
SOCIETE ANONYME SHABDIZ
Dist., Marmon Herrington, (Mercurys).
Teheran: 166 Saadi Ave. SHABDIZ. Stanley Shashoua, mgr.
TUBOSCOPE CO. INT.
Inspection of oil field tubular goods.
Abadan: Drilling stores, Agha Jari, Via Abadan, South Iran. Forrest Penley, mgr.

ISRAEL

INDUSTRIAL & ENG. ENTERPRISES
Dist., Dresser Mfg. (pipe couplings and fittings).
Tel-Aviv: Box 1298.
JOHANANOFF STAPLES & SPEC.
Dist., DuPont Co. (elastomers, polychemicals).
Tel-Aviv: No. 1 Jaffa Road. Box 3007.
CHRISTENSEN DIAMOND PROD.
Diamond coring and drilling equipment
Tel Aviv: 6, Ahuzat Bait Street, P. O. Box 722. Raphael Ben Yosef, mgr.
LANDSEAS EASTERN COMPANY
Dist., Continental-Emsco, (drilling and producing equipment).
Tel Aviv: Box 2554. EASTLAND.
MAKHTESH MINING AND QUARRY
Dist., Guiberson Corp.-Dresser Industries, (oilfield equipment, rubber products).

Tel Aviv: P. O. Box 1837.

J. SAKER & CO.

Dist., Oil Well Supply, (oilfield supplies).

Haifa: 33 Hazmauth Road.

RAPHAEL BEN YOSEF

Dist., American Iron & Machine (packers & overshots); Cardwell (portable rigs, winches, hoists, drawworks); Chiksan Export (swing joints, circulating heads, mud guns, steel rotary hose); Martin Decker (indicating & recording drilling control instruments); Web Wilson (drilling tools).

Tel Aviv: P. O. Box 722.

CHEMICALS & TECH. SUPPLIES

Dist., DuPont Co. (photo products).

Tel-Aviv: Box 10.

ISRAEL ENGINES & TRAILERS

Dist. Aeroquip, (aviation and hydraulic equipment).

Tel Aviv: Box 390.

NISSEN PREMINGER LTD.

Dist., Acme Protection Equipment (gas masks).

Tel-Aviv: 1 Hashahar St. Tel. 66624.

ARAVAH ATI LTD.

Dist., Insley (trench hoes, excavators, cranes); Chiksan Export (swing joints, circulating heads, mud guns, steel rotary hose).

Tel-Aviv: PEC Bldg. Room 602. Box 722.

HANNS BEERMANN

Dist., Beryllium (copper rod alloys and casting ingots).

Tel-Aviv: 2 Yefe Nef St.

ITALY

A.G.O.I.

Dist., Shand & Jurs — GP sub. (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, data logging).

Milan: Via Panizza 11.

AGENZIA RAPPRESENTANZE ESTEREE NAZIONALI

Dist., Bowen Itco, (fishing tools, rotary jars, wire lines, pressure controls); Cardwell (portable rigs, winches, masts, hoists, drawworks).

ROME: 5 Via Modena. Tel. 44074. ARENTELE. Mgr. Terzo De Angelis.

BAROID-MAFFEI S.p.A.

Drilling mud products and services, mud analysis well logging.

Milan: 32 Piazza Republica. Tel. 63-97-20. BAROID. Cesare M. Maffei, ch. of bd., Italo Maffei, mang. dir., Norman K. Tschirley, tech sales dir.

BRUNO BATTILANA

Dist., Shand & Jurs, (valves, controls, processing equipment, data-logging, automatic computing, and control equipment).

Trieste: Via Mazzini 4. Tel. 38-263. BATBEL.

BIMALT S.R.L.

Dist., Metallizing Engineering, (metallizing equipment, wires).

Milan: Via Conservatorio 15. BIMALT. Angelo Bianchi, mgr.

A. R. BEARDSLEY

Dist., Ebasco Services, (engineering, construction, and business consulting services).

Milan: Viale Regina Giovanna, 32. A. R. Beardsley, mgr.

CAICOMES

Dist., Well Instrument Developing, (electric well logging equipment).

ROME: Via Asmara 7. Villa Maria. Tel. 813.017-813.018. CAICOMES. C. J. Bujalski, mgr.

ING. CASTAGNETTI & C.

Dist., Olin Cuno Filter, (industrial filters).

Torino: Via Sacchi, 28 bis. OLCUNO. Ing. Guido Eva, mgr.

DITTA ALESSANDRO GAETA

Dist., Mexico Refractories, (refractory castables, mortars, ramming materials, firebrick).

Genoa: Via Settembre 14-12. Tel. Interc. 51-358. DEOXIDO. Dr. Marco Bussetti, mgr.

FORNITURE INDUSTRIAL e PETROL

Dist., Cameron Iron Works, Inc., (blowout preventers, Xmas trees, valves and instruments).

Milano: Via Manin 37. Tel. 650.450. FIPSUPPLY. Dott. Florindo Licini, mgr.

ERCOLE MARELLI & C.S.p.A.

Dist., Carrier Corp., (air conditioning, refrigeration, heating).

Rome: Via S. Nicola da Tolentino 15-18. VENTILATOR.

HEURTEY ITALIANA

Dist., Petro-Chem Development, (services for fluid refinery and chemical plant heaters).

Milan: Via Leopardi, 24. Tel. N. 898. 222-861.384. GAZHEURTEY. P. N. Fehr, mgr.

IL CINGOLO, S.p.A.

Dist., LaTourneau-Westinghouse Co., (construction machinery).

Milan: Piazza F. Meda, 5. GIRARDON.

METALNOVA, S.p.A.

Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).

Milan: Via G. Fara, 39.

MARELLI AEROTECNICA

Dist., Carrier Corp. (air conditioning, refrigeration, heating).

Milano: Casella Postale 4189. Via Vincenzo Lancetti, 43. Tel. 680.941/5, 683.741/5.

NALCO ITALIANA SOCIETA

Dist., National Aluminate (chemicals for treatment of industrial waters and petroleum. Herbicides, corrosion inhibitors, and coagulants).

Rome: Via Sardegna, 50. Tel. 484754. ITALNALCO. A. Cantalini, mgr.

DOTT. P. G. GIACOBINO

Dist., Grant Oil Tools (oil well drilling tools and oil well production equipment); Shaffer Tool (blowout preventers, flow beans, casing heads, drill equipment, etc.).

Milano: Via Giustiniano, No. 6, Tel. 27.36.28. Dott. P. G. Giacobino, mgr.

ORONZIO DE NORA IMPIANTI ELECTROCHIMICI

Dist., Carboline Co., (protective coatings).

Milan: Oronzio de Nora, mgr.

PETROLEUM MACH. & SER

Dist., Continental-Emsco, (drilling and producing equipment).

Milano: Via Dante 4. Tel. 802.953. MARPOLI. Dr. M. Politi, pres.

RAPPRESENTANZE FORNITURE PETROLIFERE, S.r.l.

Dist., Wilson Manufacturing (rigs, winches, pumps, masts); Web Wilson Tools (drilling tools); Chiksan Export (swing joints, all steel rotary hose, circulating heads, mud guns, etc.).

Milano: Via Manin 37. Tel. 65.04.50. RFP. F. Licini, gen. mgr.; Piero Chiapponi (Web Wilson).

REGULATOR S.R.L.

Dist., General Precision, (valves, controls, processing equipment, data-logging, automatic computing and control equipment); GPE Controls (hydraulic, electronic controls, general systems).

Milano: Corso di Porta Romana N. 132. REGULATOR.

R. ROSAUER & CO.

Dist., Oil Well Supply, (oilfield supplies); Eastman Oil Well Survey (directional drilling oil well surveying, star recorders).

Rome: Via Sommacampagna 9.

S.P.A. RIMI

Dist., Armstrong Machine Works, (traps).

SERNAVI

Dist., Shand and Jurs-GP sub. (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, data logging).

Geneo: Via Roma 8. Tel. 56.957-586. 023. SERNAVI.

SOCIETE MIDEC

Dist., George F. Failing (drilling rigs); Bucyrus-Erie (drilling rigs, construction machinery).

Milano: Corso de Porto Nuovo No. 3.

TERZO DE ANGELIS — A.R.E.M.

Dist., Jet Lube, (thread compounds for drill collars, tool joints, casing & tubing, oilfield grease specialties).

Rome: Via Modena 5.

BREDA FUCINE S.P.A.

Dist., American Iron & Machine (packers, overshots).

Milano: Casella Postale 3686. Sesto S. Giovanni. BREDA FUCINE. Gaetano Gaspari, mgr.

G. CASTELLAZO

Dist., Barton Instrument (twin bellow flow meters).

Genoa: Lungobisagno Istria 34. Tel. 83318-876, 873.

SIRPLES

Dist., Dresser Manufacturing (pipe couplings and fittings).

Milan: Corso Venezia 37.

CANTIERI DEL TIRRENO

Dist., Dresser Industries — Clark Bros. (compressors, engines, gas turbines); Roots-Connersville Blower (blowers, meters, vacuum pumps).

Genoa

CANTIERI NAVALI RIUNITI

Dist., Clark Bros. (compressors, engines, gas turbines).

Genoa

CASTELLI SOC. ACC. SEMPL

Dist., Union Carbide (metal-cutting tools, heat and corrosion-resistant alloys).

Milan

EIGENMANN & VERONELLI

Dist., Union Carbide (chemicals, molecular sieves).

Milan

HOTIMSKY, S.J.

Dist., Curtis Wright (alloy steel pressure pipe).

Milan: Box 4178. Tel. 667881. HOTIMSKY.

JUCKER, SPA

Dist., Magnetrol Inc. (liquid level controls, boiler water level controllers, flow alarm switches).

Milano: Via Macchi 28. Tel. 27,83,05. A. Saibene, mgr.

LAB. ING. C. PAVONE

Dist., Branson Instrument (ultrasonic gaging & cleaning equipment and flaw detectors).

Milano: Via Natale Battaglia No. 12. INGEPAVO.

MAESTRELLI, I.

Dist., Ideco-Dresser Industries (drilling rigs, drilling & production equipment).

Rome: Via Modena 5. Tel. 44-074. RENMAESTR. A. B. Elleman, mgr.

MOLE NORTON, SPA

Dist., Norton Behr-Manning porous mediums, catalyst, carriers, bricks, cement special shapes).

Milano

ITALO VENEZIANI

Dist., National Supply (oilfield supplies).

Bologna: Via Castiglione, 20. Tel.

36100. ITALDRILL. Italo.

MARIANO AMICO
Dist., National Supply (oilwell drilling supplies).
Rome: Via dei Valeri, 1. Tel. 748191. ITALDRILL.

M. TIEGHI & CO.
Dist., Barton Instrument (twin bellow flow meters).
Milano: Via P Amedeo 3. Tel. 652-341.

CO. ITALIAN WESTINGHOUSE
(Freni e Segnali)
Pneumatic controls, hydraulic surge dampening.
Torino: Via Pier Carlo Boggio 20.

CO. TECNICA INDUSTRIES PETROL
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Rome: Via Sapri 7. PETROLTEE.

CHILDERS ITALIANA
Dist., W. H. Curtin (lab apparatus, testing equipment, regeant chemicals).
La Spezia: Rep. Uff. Canaletto, 85. Tel. 25. 167. G. Ferrari, mgr.

ERISKEN, RAIF
Dist., American Iron & Machine (packers & overshots).
Rome: c/o AMF Via Lazio 9.

FRATELLI AMOS SPA
Dist., Beryllium (copper rod alloys & castings, ingots).
Milan: Via S. Canzio. No. 13/15.

DOTT ALDO GARZANTI
Dist., DuPont Co. (photo products, petrochemicals, polychemicals, elastomers, finishes).
Milano: Via Spiga 30.

HAWKINS, S. R.
(c/o Nuovo Pignone)
Dist., Ideco-Dresser Industries (drilling rigs, drilling & production equipment).
Florence: Via Panciatichi 97. Tel. 412-663. IDECOHAWK.

NYMCO
Dist., Oakite Products (cleaning & descaling compounds); Petrolite (chemical demulsifiers, desalters, corrosion inhibitors, etc.)
Milano: 33 Via Bordoni. Dr. A. Ricotti, mgr.
Rome: (Petrolite) 9, Lungotevere A. da Brescia. Tel. 378.242-3-4. NIMCOSPA. James J. Ryan, mgr.

PETROLITE CORP.
Tretolite chemical demulsifiers, desalters, corrosion inhibitors, etc.
Rome: 149 Via Nemorense. Tel. 88-62-49. F. E. Love, O. Wagner, mgrs.

PREMABERGO ITALIANA
Dist., T. D. Williams (tapping machines, stopples, pigs, casing seals, insulators).
Rome: Viale della Tecnica 103. Tel. 526582. PREMABERGO. Angelo Anfossi, mgr.

QUAGLIERINI & CO.
Dist., Aeroquip (hydraulic & aviation equipment).
Livorno: 203 Via Grande.

SCALFI, A.
Dist., Security Inter'l.-Dresser Industries (valves, alloys, rock bits).
Milan: Via A. Saffi 29.

SOCIETE ITALIANA E. KIRCHNER
Dist., Selas Corp. (tubular furnaces for continuous processing, burners, dehydrators).
Milano: Via M. Gioia, 133. Tel. 690. 673. KIRFORNI. Dr. E. Gualandris, mgr.

SORATTE
Dist., Hills-McCanna (diaphragm valves, chemical, metering & proportioning pumps).
Rome: Piazza Venezia 5.

TERMOKIMIK CORP.
Dist., General Controls Co. (automatic control valves).
Milano: Via Flumendosa 13. Tel. 25. 69. 141-43-42. TERMOKIMIK. Pio Castellani, mgr.

WORTHINGTON SOCIETA ITALIANA POME E COMPRESSORS
Heating, airconditioning refrigeration, pumps, compressors, etc.
Milan

SOC. CARRARO & C.
Dist., Dewrance & Co. (steam traps, strainers).
Milano: Via Sonsovino, 14.

JAPAN

ASANO BUSSAN CO.
Dist., McCullough Tool Co. (wire line and fishing tools); Eastman Oil Well Survey (directional drilling, oil well surveying); National Supply (oilfield supplies).
Tokyo: New Kaijo Bldg. 6 Marunouchi, 1-Chome Chiyoda-Ku. Tel. Tokyo (28) 452-1.

BOSWELL INTERNATIONAL, INC.
Dist., Lane Wells, (Technical oilfield services, perforating, well logging, packers); Security Inter'l. — Dresser Industries (valves, alloys, rock bits); Baker Oil Tools (technical advice); American Iron & Machinery (packers and overshots).
Tokyo: 401 Sanshin Bldg., 1-10 Yuraku-Cho, Chiyoda-Ku. BOSWECO

GOSHO CO., LTD.
Dist., Well Instrument Development (electric well logging equipment).
Osaka: No. 11, 1-chome, Yokobori, Higashi-ku, Osaka. C.P.O. Box 35. GOSHO.

FRAZAR INTERNATIONAL (JAPAN)
Dist., LeTourneau-Westinghouse, (construction machinery).
Tokyo: Room 401 Yaesu Bldg. 6,2-Chome Marunouchi, Chiyoda-Ku. FRAZAR.

HATTORI TRADING CO., LTD.
Dist., Hercules Motors (Hercules and Hall-Scott gasoline and diesel engines, Lycoming gasoline engines).
Tokyo: No. 5, Nishi 4-Chome. S. Hijikata, dir.

ISHKAWAJIMA HEAVY INDUS. CO.
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction.
Tokyo: 2-Chome, Fukagawa-Toyosu, Koto-Ku. IHICO.

JAPAN GASOLINE CO.
Dist., Brown Fintube (heat exchangers).
Tokyo: New Ohtemachi Bldg. No. 4, 2-Chome, Ohtemachi. Tel. Tokyo (211) 2651-9. Masao Saneyoshi, mgr. ANTI-KNOCK.

KYOKUTO BOEKI KAISHA
Dist., Curtis Wright (alloy steel pressure pipe).
Tokyo: No. 696 Marunouchi Bldg. Chiyoda-ku (20) 0551-9. J. Sato, director. MERCANTILE. J. Sato, dir.

MARUWA BUSSAN K.K.
Dist., Petrolite (Tretolite chemical demulsifiers, desalters, corrosion inhibitors, etc.).
Tokyo: No. 3, 2-chome, Kyobashi, Chouku, Tel. 56-4890. MARUBUSSAN. K. Kikuchi, mgr.

NIIGATA WORTHINGTON, LTD.
Heating, refrigeration, air conditioning, compressors, pumps.
Tokyo

OKURA ELECTRIC CO.
Dist., Swartwout (autronic control components and systems).
Tokyo: No. 2-407 Nishitamachi, Sugimami. Tel. Jumpei Okura. ELECTO-KURA.

TOYO MENKA KAISHA, LTD.
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).
Tokyo: Box 183. Central. TOYO-MENKA.

HALLIKAINEN INSTRUMENTS
Industrial and scientific instruments.
Osaka: 1-Chome, Minamehonmachi. PEACOCK. S. Shinoya, mgr.

ENGELHARD INDUSTRIES KABUSHIKI KAISHA
Petroleum catalysts.
Tokyo: Gadelius Bldg. 3-19 Denma-Cho. Akasaka, Minato-ku.

DAIICHI JITSUGYO CO.
Dist., Hills McCanna (diaphragm valves, chemical, metering and proportioning pumps).
Tokyo: Shuzui Bldg. 6, 2-Chome Kyobashi, Chuo-Ku.

CHIYODA CHEMICAL ENGR. & CONS. CO.
Dist., Petrolite Corp. (Petreco electric desalting, dehydrating, distillate treating, lube oil treating, etc.).
Tokyo: Tokyo Bldg. Tel. 20 — 0121 to 9. CHIYOTAKA. T. Yamada, mgr.

INTER'L. MACHINE CO.
Dist., Selas Corp. (tubular furnaces for continuous processing burners, dehydrators).
Tokyo: Nikkatsu Inter'l Bldg. No. 1-1 Yurakucho Chiyoda-ku. Box 726. Tel. 27-5863, 5864, 5110, 6052. OUTREMER. Futaki Nobu, pres.

INTER'L PRODUCTS CO.
Dist., Armour Chemical (production, refining chemicals, refined product additives, technical sales service).
Tokyo: Suite 760 Marunouchi Bldg. Chiyoda-Ku. Tel. 20-3479, 20-3723, 56-3520. JIROKA. Nakaji Ohnuki, mgr.

ISHIMOTO TRADING CO.
Dist. Oakite (cleaning & descaling compounds).
Tokyo: Sekiyama Bldg. 5 Kama Kuracho, Kanda. Chiyoda-Ku.

TSUGAMI TRADING CORP.
Dist., Armite (anti-seize and sealing compounds, drill collar and tool joint compounds).
Tokyo: 1, 4-Chome, Tamura, Cho, Shiba, Minato-Ku. M. Uehara, mgr.

AMERICAN JAPAN TRADING CO.
Dist., Insley (trench hoes, excavators, cranes, bucketcarts); DuPont Co. (photo products, elastomers, explosives, polychemicals, finishes); Vapor Recovery Systems (equipment related to storage and transportation of liquids).
Osaka: No. 420, 4-Chome Kujo. Nakadori, Nishi-Ku. Tadao Fujimoto, asst. mgr. Tel. SHINMACHI, 5119.
Osaka: (DuPont) No. 47, 2-Chome Andojibashi-Dori. Minami-Ku.
Tokyo: SKF Bldg. No. 1 Shiba Park 7-Gochi. Minato-Ku.

MARUWA BUSSAN K.K.
Dist., DuPont Co. (polychemicals).
Tokyo: No. 2, Tori-2-Chome Nihonbashi. Chuo-Ku.

CHIYODA-KU ENGINEERING & CONS. CO.
Dist., Clark Bros. (compressors, engines, gas turbines).
Tokyo: Tokyo Bldg., No. 3 Marunouchi 2-Chome.

DAIICHI BUSSAN KAISHA, LTD.
Dist., Southwestern Indus. Electronics — Dresser Industries (seismograph equipment); Bucyrus-Erie (drilling rigs, construction machinery).
Tokyo: Shibatamura-Cho, Minato. Ku.

HOKUSHIN ELECTRIC WORKS
Dist., Barton Instrument: (twin bellow flow meters).
Tokyo: 312 Shimomaruko-Cho, Ota-ku. Tel. Kamata (73)-2241.

TOKYO MERCHANDISE CO.
Dist., Chiksan Export (swing joints, all steel rotary hoses, circulating heads, mud guns, reamers, etc.)
Tokyo: Tokuda Bldg., No. 21, 2-Chome. Nihonbashi-Kabuto-Cho. Tel. 672151, 672156, 671087. TOMAS. Y. Matsumiya, mgr.

YOKOHAMA RUBBER CO.
Dist., Aeroquip (hydraulic and aviation equipment).
Tokyo: Box 46 Shiba.

IINO-TEARS c/o IINO SHIPBUILDING & ENGINEERING CO., LTD.
Dist., Tears Engineers, (design and construction of complete process units, oil refining petrochemicals and chemicals).
Tokyo: 6 Marunouchi, 3-Chome, Chiyoda-Ku. M. Hiraoka, mgr.

C. ITOH & CO., LTD.
Dist., Tracerlab, Inc. (nuclear instrumentation, radiation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Tokyo: No. 4, 2-Chome, Hon-Cho, Nihonbashi, Chuo-ku.

F. KANEMATSU & CO. LTD.
Dist., Quaker Oats, (furfural).
Tokyo: New Kaijo Bldg. Marunouchi. Tel. 28-6811. KANEMATSU. G. Miura, mgr.

KYOKUTO BOEKI KAISHA, LTD.
Dist., Oil Well Supply (oilfield supplies).
Tokyo: 696 Marunouhi Bldg.

MATSUSHITA ELECTRIC INDUS.
Dist., Arcair Co. (metal removal torches, copperclad electrodes and welding supplies and accessories).
Osaka: 1006 Kadoma. Tel. Osaka (33) 4331-4336. MATSUDEN MORIGUTI. H. Tanimura, dir.

W. MAHONEY
Dist., Ebasco Services, Inc. (engineering, construction and business consulting services).
Tokyo: Teito Hotel. W. Mahoney, mgr.

MORITANI & CO., LTD.
Dist., W. W. Nugent, (Oil filters, lubricating systems for pipelines).
Tokyo: No. 3, Nichome, Yaesu, Chuo-Ku. Tel. Chiyoda (27) 2681-5. MARITANI. Ichiro Moritani, mgr.

NIHON REGULATOR CO., LTD.
Dist., GPE Controls-GP sub. (valves, controls, processing equipment, data-logging, automatic computing and control equipment).
Tokyo: Sanwa Bldg., Yaesu 1-Chome. NIRECO-TOKYO.

NISSHO CO. LTD.
Dist., Solar Aircraft (industrial bellows and expansion joints); Houdry Process (Houdry processes).
Tokyo: Tokyo Boeki Kaikan Bldg. 2, 1-Chome, Otemachi. Chiyoka-Ku. Tel. (23) 7511-21-31-41-51-61. (28)2921. (28) 2931. NISSHOCONY. K. Ishitani, mgr.

OKAZAKI TRADING CO. LTD.
Dist., Aero-Research Ins. Co., Inc. (high temperatures insulated thermocouple wire & thermocouples, probes, resistance bulbs, pressure and static probes).
Tokyo: No. 6, 3-Chome, Tsukiju, Chuo-Ku. Tel. Higashi-Ginza 54-5951. Central Box No. 620. Ereki Tokyo. Y. Okazaki, pres.

FUJINAGATA SHIPBUILDING
Dist., Petro-Chem Development (service for fluid refinery and chemical plant heaters).
Osaka: 9 Shibatanicho 2-Chome, Sumiyoshi-Ku. Tel. 67-2693. FUJINAGATA. T. Suzuki, mgr.

TOYO CARRIER ENGINEERING
Dist., Carrier Corporation, (air conditioning, refrigeration, heating).
Tokyo: No. 24, 3-Chome Nihonbashi Kabuto-cho. Chuo-ku. CARIERTOYO. Tel. Kabuto (67) 2166-9.

GADELIUS & CO., LTD.
Dist., Yarnall-Waring (blow-off valves, water gages, liquid level indicators, expansion joints steam traps, strainers).
Tokyo
Kobe

KUWAIT

NATIONAL CONTRACTING CO.
Dist., Chicago Bridge & Iron, (oil storage tanks, evaporation savings equipment, refinery vessels, steel construction).
Kuwait: Box 106. NALCO. Abdulla Alireza, mgr.

KHALIFA DIAJ EL-DABBOUS
Dist., Insley Mfg., (trench hoes, excavators, cranes, bucket carts).
Kuwait: Box 1529.

HASSAN AHMAD EBRAHIM
Dist., Arco Co., (paints and protective coatings).
Kuwait: Box 199. HASSAN.

LEBANON

BANDAWIL AND CO.
Dist., Remco Mfg. Co., (pipe line equipment).
Beirut: Rue Tripoli. Tel. 30172. Box 967. BARDA WILCO. T. C. Clelland, mgr.

CHRISTINSEN DIAMOND PROD.
Diamond coring and drilling equipment.
Beirut: Box 4116. Tel. 42728. TALOA. Percy Tinsley, mgr.

CONTRACTING AND TRADING CO.
Dist., Bowen Itco, (fishing tools, rotary jars, wire line pressure control); Oil Well Supply (oilfield supplies).
Beirut: Cat Building, Rue El-Arz, P. O. Box 1036. CAT. Tel. 21564.

GEOPHYSICAL SERVICE INTER'L.
Seismic, gravity and magnetic surveys and seismic data processing, services.
Beirut: Union National Bldg. Apt. 16. J. L. Stephens, Opera., mgr. Tel. 2-0150.

MIDDLE EAST OIL FIELD SUPPLIES
Dist., Jet Lub, (thread compounds for drill collars, tool joints, casing and tubing, oilfield grease specialties); Cameron Iron Works, (blowout preventers, Xmas trees, valves, and instruments); Baker Oil Tools (technical advice).
Beirut: Box 1036. Tel. 21564-69.

SYRIO-BENAESE CONSORTIUM
Dist., Infilco Inc., (industrial filters).
Beirut: P. O. Box 1374. Lazarieh Bldg. Blac Al. Tel. 37603. 66 SYLCONSOR. J. Balint, dir. Souhail Massouh, mgr.

UNITED TRADING CO.
Dist., Hercules Motors Corp. (Hercules and Hall-Scott gasoline & diesel engines, Lycoming gasoline engines.)
Beirut: Box 395. George Sabra, mgr.

K. L. BOURDO
Dist., Web Wilson (drilling tools); American Iron & Machine (packers & overshots); Dresser Industries-Ideco (drilling rigs & drilling & production equipment)—Security Inter'l. (valves, alloys, rock bits).
Beirut: Box 3432. TALOA.

WAHAB TAMARI & CO.
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Beirut: Abdullah Tamari.

EDMOND AYOUB
Dist., Arco (paints & protective coatings).
Birut: Box 2791. EDYOUB.

AHMED HALABY
Dist., Arco (paints & protective coatings).
Beirut: Box 2708.

BARDAWIL & CO.
Dist., Aeroquip (hydraulic & aviation equipment).
Beirut: Box 967. Rue Tripoli.

BESHARA ENGINEERED SALES
Dist., T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).

BORG-WARNER INTER'L.
Dist., Morse Chain (oilfield supplies, complete engineering services).
Beirut: 188 Rue d'Artois. Box 3321. Tel. 37259. Russel Davis, mgr. RUSDAV.

MACPHERSON-RIDGEWAY PET. EQUIP.
Dist., I. H. Grancell Co. (lead seal compound) Rockwell (meters, regulators, valves); Shaffer Tool, blowout preventers, flow beans, casing heads, control gates, high pressure & drilling equipment).
Beirut: Arida Bldg. Tel. 44058. Box 4476. MACRIDGE.

NIZAR RASLAN
Dist., Procon Inc. (chemical, petrochemical, petroleum plants).
Beirut

RIDGEWAY, WILLIAM
Dist., Magnet Cove-Dresser Industries (drilling mud & chemicals).
Beirut: Box 3432. TALOA. W. Ridgeway, mgr.

UNITED ENG. CO.
Dist., Marley (cooling towers).
Beirut: "Intra House" Rue Riad El-Solh. Box 4294. Tel. 46901 & 46902. TUNECO. Victor Kano, mgr.

AERO SERVICE CORP.
Airborne geophysical surveys, aerial photography, photo & topo maps.
Beirut: c/o O. D. Debbas & Sons. Box 3. DEBBASON. Charles Keck, rep.

LIBYA

GAYNOR & CO.
Dist., George F. Failing, (drilling rigs).
Tripoli: 18 Cathedral Square.

GEOFISICA ROGERS C.A.
Seismograph contractor.
Tripoli: 368, Sciara Istiklal. Tel. 6387. Box 881. ROGEXCO. R. W. Price, mgr.

GEOPHYSICAL SERVICE INTER'L.
Seismic, gravity and magnetic surveys and seismic data processing services.
Tripoli: 230 Giaddat Istiklal, 5th Floor, Box 592. Tel. 1510. D. M. Steel, supvsr.

INCODENA (LIBYA) LTD.
Dist., Oil Well Supply, (oilfield supplies).
Tripoli: Shara El Malika Fatma (Palazzo Albanozzo).

BOURDO, K.L.
Dist., Dresser Industries-Security Inter'l. (valves, alloys, rock bits)—Ideco (drilling rigs, drilling & production equipment); Web Wilson (drilling tools); American Iron & Machine (packers & overshots).
Tripoli: Box 682. WESBOURDO. Tel. 5577.

JACK AMANN PHOTO. ENG.
Aerial photography.
Tripoli: Box 393. C. F. W. Smith, mgr.

AERO SERVICE CORP.
Airborne geophysical surveys, aerial photography, photo & topo maps.
Tripoli: Box 347. AERCORP. Wadia Ashkar, rep.

MEXICO

AGENCIA COMERICAL URIARTE
Dist., J. H. Williams & Co., (wrenches, sockets, chain pipe tongs, vises).
Mexico City: 42 Puentede Alvarado.

No. 71. Desp. 203 Tel. 21-68-82. U. De Uriarte, mgr.

AMERICAN BODY & EQUIPMENT
Dist., Marmon-Herrington, (Fords).
Mexico City: Calle Oriente 171 No. 459. Apartado 26809. Robert Hervey, pres.

AUTO SERVICE, S.A.
Dist., Tulsa Winch, (winches, power take-offs, speed reducers, transmissions).
Mexico City: Calle Tolsa No. 44.

AMEREX INGENIEROS
Dist., Mexico Refractories, (refractory castables, mortars, ramming materials, firebrick).
Mexico City: Ixtaccihautl 6. Apartado Postal 30150. Tel. 11-15-16. 11-41-07. AMEREX. Jorge Martin Ruiz, mgr.

BROWN AND ROOT DE MEXICO
Construction process plants for oil, gas, and chemical industries.
Mexico City: Juarez 134 — Despacho 405. Tel. 46-17-88. Charles L. Ottinger, Jr., mgr.

CASA WIESLEY, S.A.
Dist., Eastman Oil Well Survey, (directional drilling, oil well surveying).
Mexico City: Edison 18. Tel. 46-09-86 and 12-72-19. P. O. Box 1617. David Wiesley, pres.

CAMERON IRON WORKS—MEXICO
Blowout preventers, Xmas trees, valves, instruments.
Mexico City: Paseo de la Reforma No. 76. Tel. 46-87-63. E. L. Barker, mgr.

PANAMERICANA DE EQUIPOS
Dist., Guiberson Corp. (oilfield equipment and molded rubber products); Wilson Manufacturing (rigs, winches, masts, pumps).
Mexico City: Balderas 36-407. Tel. 21-74-37. G. E. Daniels, mgr.

CONSULTORES Y ABASTECEDORES
Dist., Wm. W. Nugent & Co., (oil filters, lubricating systems for pipe lines).
Mexico City: Dolores No. 17-301. P.O. Box 8554. D. M. Booth, mgr.

DALMA COMERCIAL, S.A.
Dist., Shand and Jurs-GP sub. (safety equipment for storage tanks, tankers, automatic level gaging, control equipment systems engineering).
Mexico City: Plaza Santos Degollado 10.

DISTRIBUIDORA DE EQUIPOS DE CONSTRUCCION
Dist., George F. Failing (drilling rigs); LeTourneau-Westinghouse, (construction machinery); Northwest Engineering, (shovels, cranes, draglines, pullshovels).
Mexico City: Box 318.
Mexico City: Apartado 7358. Roma 37, Esq. Viena. G. McLaughlin, mgr.

ELECTRODES COMMONWEALTH DE MEXICO, S.A.
Dist., Modern Engineering, (oxy-acetylene welding and cutting apparatus and supplies).
Mexico City: Calzada Ingenieres Militares, No. 16. San Bartolo Naucalpan. P. O. Box 23511.

ELIZONDO, S.A.
Dist., Carrier Corp. (air conditioning, refrigeration, heating).
Mexico City: Calle Lafragua No. 4, Despacho No. 502. Tel. 46-34-94.
Monterrey: P. O. Box 1450. Tel. 2-33-95.

EQUIPO HERRAMIENTAS & MATERIALES
Dist., D. W. Onan and Sons. Electric plants, generators, air cooled engines.
Mexico City: 5A Callae Guellero. Esq. Con Carlos J: Meneses.

ENGER CORP.
Dist., Cabot Shops & Franks Div. (pumping units, drilling, well servicing, workover equip.); Midwestern Pipe Line Products, (pipe wrapping materials); Grant Oil Tools, (drilling tools and production equipment).
Mexico City: Gral. S. Alvarado No. 12. P. O. Box 24665. Tel. 15-11-83, 15-68-45. Ernesto Englander, mgr.

C. NORMAN FREES
Dist., Babcock & Wilcox, (pipe, tubing, steels, fittings, flanges in carbon, alloy, stainless steels); Ladish (pipe fittings).
Mexico City: Buena Vista No. 3, Despacho 505. Tel. 10-12-87. Norman Frees, mgr.

GEOPHYSICAL SERVICE INTER'L.
Seismic, gravity, magnetic surveys, seismic data processing services.
Mexico City: Avenida Juarez 119, Despacho 42. Tel. 36-37-20. John Donna, supvsr., Marvin Wagoner, supvsr.

GOMEZ HERNANDEZ & CIA.
Dist., Cooper Alloy Corp., (valves and fittings).
Mexico City: Matamoros 4.

HERRAMIENTAS THOR DE MEXICO
Dist., Thor Power Tool, (portable power electric & air tools, construction machinery, vibrators, trowels, generators, screens.
Mexico City: Basilio Badillo 47. Apartdo 701. Tel. 18-65-27. C. L. Rowett, mgr.

HOMCO DE MEXICO
Oilwell fishing tools, directional drilling, oilfield supplies.
Mexico City: Edificio Reforma Versalles, Paso de la Reforma No. 76. Tel. 46-73-63. Armando D. Reed, mgr.

INFILCO MEXICANA, S.A.
Industrial filters.
Mexico City: Plaza de los Ferrocarriles, No. 3, 4 Piso. Tel. 46-22-66. INFILCOMEX. Rodriguez Garcia, vice pres. & mgr. Bernado de la Torre.

JOHNSTON PUMP CO. DE MEXICO
Dist., Continental-Emsco, (drilling & producing equipment).
Mexico City: Vallarta 8th Floor. Tel. 46-26-86. Salvador Madero, Jr., pres.

LUFKIN FOUNDRY & MACHINE
Pumping units and gas engines.
Mexico City: Apartado Postal 7506. Tel. 35-29-45. Gene Towle, mgr.

MISCO, S.A. MISCO
Dist., Armstrong Machine Works, (traps).
Mexico City: Dr. Jimenez 23. A. C. Miselem, mgr.

ALBERTO NATHAN
Dist., Oil Well Supply, (oilfield supplies).
Mexico City: Avenida Juarez 64-608.

PHILLIPS S.E.T.
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Mexico City: Durango 167.

PRODUCTORA DE OXIGENO
Modern Engineering, (Oxy-acetylene welding and cutting apparatus & supplies); Metallizing Engineering, (metallizing equipment, wires).
Monterrey: 5 de Mayo, 1175 Pte. Apartado 318. Esteban Rock, mgr.

PROPESA
Dist., Jet-Lube, (thread compounds for drill collars, tool joints, casing and tubing, oilfield grease specialties); Orbit Valves.
Mexico City: Paseo de la Reforma No. 122-4BB.

S.I.E. REPRESENTACIONES
Dist., Well Instrument Develop., (electric well logging equipment)).
Mexico City: LaFragua 13. Despacho 201. Henry G. Escamilla, mgr.

G. SAAVEDRA E HIJOS, S. de R.L.
Dist., Mission Mfg. (oilfield equipment); Lane Wells (technical oilfield services, perforating, well logging, packers).
Mexico City: Avenida Morelos 31. ARDEVAAS.

SCHULTZ Y CIA
Dist., American Meter, (pump division — proportioning pumps); Vapor Recovery System (equipment related to storage & transportation of liquids); Magnetrol (liquid level controls, boiler water level controllers, flow alarm switches).
Mexico City: Melchor Ocampo 340. Tel. 46-67-79. Virgil Shultz, mgr.
Monterrey: Aramberri 509 Pte. Tel. 2-99-33. W. A. Rock, mgr.

PROVEEDOR DEL SOLDADOR
Dist., Modern Engineering, (oxy-acetylene welding, cutting apparatus, supplies).
Monterrey: Emilio Carranza Ntd. 929.

MIGUEL ANGEL ROCA
Dist., Brown Oil Tools, (well completion service, liner packers).
Mexico City: Patriotismo 12-1.

ALFREDO C. SUESS
Dist., Modern Engineering, (oxy-acetylene welding and cutting apparatus, supplies).
Monterrey: Arteaga Ote 635.

JOY SULLIVAN MACHINERY
Dist., John Bean, Div., Food Machinery & Chem Co. (core drilling pumps, high pressure piston pumps).
Mexico City: Insurgentes Sur 132. Tel. 46-28-06. R. H. Edbrstadt, mgr.

GENE TOWLE
Dist., Oil Base, Inc., (field engineering service); Lufkin Foundry & Machine, (pumping units and gas engines).
Mexico City: Apartado Postal 304. Tel. 25-46.54. Gene Towle, mgr.

UQUILLAS-SOTA, S.A.
Dist., Hilliard Corp., (filtering items).
Mexico City: Guanajuato 202. Tel. 14-28-19. Humberto Uquillas, mgr.

USA-MEX, S.A.
Dist., Black, Sivalls and Bryson, (oilfield equipment).
Mexico City: Paseo de la Reforma. 122-4 Piso. (Apartado 20939). UMEXA.

LUIS C. VALAZQUEZ
Dist., Baldwin-Lima-Hamilton Construction Equip. Div. (cranes, crawler, wheel or truck mounted, other construction equipment).
Mexico City: Ario No. 12, Tel. 146106.

TUBORREY, S.A.
Dist., Dresser Mfg. (couplings, pipe clamps, sleeves).
Monterrey: Apartado 1180.

ESCAMILLA, HENRY G.
Dist., Southwestern Indus. Electronics Co.-Dresser Industries (seismograph equipment).
Mexico City: Edison 40-1.

CO. COMERCIO DE EXTERIOR
Dist., Magnet Cove Barium-Dresser Industries (drilling muds & chemicals).
Mexico City: Apartado 1009. Rio Elba Num. 17, Desps. 303. BERENTSEN.

EQUIPOS DE PROCESO, S.A.
Dist., Roots-Connersville Blower-Dresser Industries (blowers, meters, vacuum pumps).
Mexico City: Ave. Ejercito Nacional No. 1019.

EQUIPOS MECANICOS, S.A.
Dist., Bucyrus-Erie (drills, construction machinery).
Mexico City
Guadalajara

EQUIPOS MECANICOS DEL NORTE
Dist., Bucyrus-Erie (drills, construction machinery).
Monterrey
Tampico

EQUIPOS & SERVICIOS INDUS.
Dist., Rockwell (meters, valves, regulators).
Mexico City: Apartado 30105.

ESPECIALIDADES INDUSTRIALES
Dist., Rockwell (meters, valves, regulators); Roots Connersville Blower-Dresser Industries (blowers, meters, vacuum pumps); Hilliard Corp. (filtering items).
Monterrey: Apartado 1230. P. Mier 1271 Pte. Tel. 2-64-22. EISA. Rosendo Cabaelero, mgr.
Monterrey: Apartado 1230.

BEZAURY, S.A.
Dist., Hills McCanna (diaphragm valves, chemical, metering & proportioning pumps).
Mexico City: 3 Calle De Lago Xochimilco No. 121. Colonia Anahuac.

BORG WARNER INTER'L.
Dist., Morse Chain (oilfield supplies, engineering services).
Mexico City: Apartado 23767, Administracion de Correos No. 10. Tel. 20-67-81. Charles H. Bleiler, mgr.

BRYON JACKSON CO., S.A.
Rotary tongs.
Mexico City: Plaża de la Republica 9-106. Box 21125. Tel. 21-49-41. Rafael Torres, mgr.

PANAMERICANA DE EQUIPOS
Dist., American Iron & Machine (packers & overshots); Wilson Mfg. (rigs, winches, masts, pumps).
Mexico City: Balderas 36-407. Guy Daniels, mgr.

CURTIN DE MEXICO
Lab apparatus, petroleum testing equipment, reagent chemicals.
Mexico City: Antonio Maura 29. Box 26265. Tel. 19-83-65. Joe Evans, mgr.

DOERR, ALBERT, CO.
Dist., Shaffer Tool (blowout preventers, flow beans, casing heads, control gates, hookups, drilling equipment, etc.).
Mexico City: Durango 199. Apartado 427. Tel. 14-66-10/13. Karl P. Doerr, mgr.

EQUIPOS DE SEGURIDAD
Dist., Acme Protection (gas masks).
Mexico City: Rosas Moreno No. 152-B. Tel. 36-59-44, 35-25-12. Raul Mejia Chavez, mgr.

FABRICAS PROTEXA, S.A.
Dist., Gulf States Asphalt (canal & reservoir lining, asphalt products).
Monterrey: Santa Catarina. Box 1141. Tel. 6-1212. Humberto Lobo, mgr.

PEDRO DE GARAY
Dist., Baker Oil Tool (technical advice).
Mexico City: Jesus Urquiaga No. 30. Colonia del Valle. Tel. 23-96-86.

GENERAL MOTORS DE MEXICO
Diesel engines, vehicles, spare parts, service.
Mexico City: Ave. Ejercito Nacional 185. Tel. Mexicana 35-48-90, Ericsson 11-95-00. GENMOTOMEX.

GODARD, C.L.
Dist., Westinghouse Air Brake (pneumatic controls for oil industry, hydraulic surge dampening).
Mexico City: Avenida Juarez 76. Box Edificio Aztlan, Desp. 507.

HOMCO.
Dist., W. C. Norris (sucker rods).
Mexico City: Paseo De La Reforma No. 76. Desp. 503.

J. M. DE LA GARZA CARDENAS
Dist., Security Inter'l.-Dresser Industries (valves, alloys, rock bits).
Mexico City: c/o Perforadora Latina, Madrid 21.

INNES, GEORGE
Dist., Young Radiator Co. (heat transfer products).
Mexico City: Varsovia No. 58-A. Tel. 11-70-49.

SOCIEDAD ELECTROMECANICA
Dist., Young Radiator (heat transfer products).
Mexico City: Manuel Ma. Contreras No. 25. Col. San Rafael.

NATIONAL CARBON-EVEREADY
Dist., Union Carbide (chemicals, metal-cutting tools, silicones).
Monterrey
Mexico City
Guadalajara

UNION CARBIDE INTER-AMERICA
Chemicals, welding & cutting equipment, metal-cutting tools, etc.
Mexico City
Monterrey
Guadalajara

DUPONT, S.A. DE C.V.
Photo products, petroleum chemicals, polychemicals, finishes, elastomers.
Mexico City: Av. Jaurez 117, 4/0. Piso. Apartado 1799 Y 61.

MEXICANA DE EXPLOSIVOS
Dist., DuPont Co. (explosives).
Mexico City: Av. Juarez 117-2/0. Piso. Apartado 43 Bis.

BERRY, ALLEN
Dist., Ideco-Dresser Industries (drilling rigs, drilling & production equipment).
Mexico City: Fifth Floor, Paris No. 15. Tel. 46-75-05. IDECO.

SERVICIOS PETROLEROS, EISA
Dist., Ideco-Dresser Industries (drilling rigs, drilling & production equipment).
Mexico City: Fifth Floor, Paris No. 15. Tel. 46-75-05.

MAQUINARIA PANAMERICANA
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Mexico City: Madrid No. 21-G.

MAQUINARIA Y HERRAMIENTA
Dist., Areoquip (hydraulic & aviation equipment).
Mexico City: Ave. Morelos Num 74 .

LIMPIADORES QUIMICOS INDUS.
Dist., Oakite Products (cleaning & descaling compounds).
Mexico City: Bahia de Perula No. 17. V. M. Erana, mgr.

MOTORES Y SERVICIO WAUKESHA
Gasoline engines.
Mexico City: Patriotismo No. 12. Tel. 15-03-32. M. A. Roca, mgr.

NATIONAL SUPPLY OF MEXICO
Oilfield supplies. Dist., Chicksan Export (swing joints, steel rotary hose, circulating heads, mud guns, reamers, disc bits, fittings).
Mexico City: Paseo de la Reforma 76-1304. Tel. 35-34-74.

PETROLITE CORP
Tretolite chemical demulsifiers, desalters, corrosion inhibitors, paraffin removers, etc. Petreco electric desalting, dehydrating, etc.)
Mexico City: Sierra de Mijes, No. 125. Tel. 20-49-48. Robert E. Power, mgr.

PROTECCION CATODICA, S.A.
Dist., T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).
Monterrey: Apartado 1141. Humberto Lobo, mgr.
Mexico City: Artes 77. Tel. 16-52-29. Ing. Hector Rivera Garza, mgr.

PROVEEDORA IND. PET.
Dist., Cardwell (portable rigs, winchs, hoists, masts, drawworks).
Mexico City: Ave. Insurgentes 82-2 Piso. Tel. 14-50-73/68.

SOC. COM. Y IND. S.A.
Dist., Armour Chemical (production, refining chemicals, refined product additives).
Mexico City: Paseo de la Reforma No. 51. Tel. 35-03-46, 35-04-02, 46-20-49. ARCUAD. E. Fabregat, mgr.

STETA, JUAN M.
Dist., Jack Ammann Photogrammetic (aerial photography).
Mexico City: c/o Baker, Botts & Miranda. Paseo de la Reforma No. 1. Tel. 46-95-70 (L.D. 188).

TUBACERO, S.A.
Dist., Kane Boiler Works (API monogram line pipe, pressure vessels, tanks, fabricated steel products).
Monterrey: Ave. de las Encinas. Apto 809. Tel. 2-44-95. Wm. L. Kane, mgr.

VALSO, S.A.
Dist., Walworth Co. (bronze valves).
Guadalajara: 8 de Julio 1800. Juan Jorge Collignon A. mgr.

WORTHINGTON DE MEXICO
Heating, refrigeration, air conditioning, pumps, compressors, etc.
Mexico City

VICAL, S.A.
Dist., Barton Inst. (twin bellow flow meter).
Mexico City 19: Miguel Angel 96-98. Tel. 24-31-34.

NICOL M.A., S.A.
Dist., Beryllium (copper rod alloys, castings, ingots).
Mexico City: 4 D. F., Maestro Antonio Case 89.
Mexico City

SHAW, WM. F.
Dist., Axelson-U. S. Indus., (pumps, rod liners).
Mexico City: Dispachio Mezzanine. Calle Liverpool #75.

REDIMA S.A.
Dist., Yarnall-Waring (blow-off valves, water gages, liquid level indicators, expansion joints, steam traps, strainers).
Mexico City

MOROCCO

INDUSTRIELLE ET COMMERCIALE
Dist., Oil Well Supply, (oilfield supplies).
Casablanca: 238 Blvd. Emile Zola. Angle Rue de Douai.

SOCIETE d'APPLICATIONS MECANIQUES ET INDUSTRIELLES
Dist., Continental-Emsco, (drilling and producing equipment).
Casablanca: 9 rue de Lille. Tel. 401-51. Rene Clipet, mgr. SAMINDUS.

NETHERLANDS

CREOLE ENG. & SUPPLY
Aruba: 14-15-16 B v.d. Vee Zeppenveldstra. Box 130 San Nicolas. Tel. 5101-1029. SUNSHINE. Emanuel Wajcberg, mgr.

GENERAL-EQUIP. H. LINSE ENG.
Dist., Tulsa Winch, (winches, power take-offs, speed reducers, transmissions).
Dribergen: 16 Rosariumlaan.

JAN DE BAS
Rep., Vermeer Mfg., (ditching machines).
Heemstede: 158 Cruquiusweg.

STONE & WEBSTER ENG. N.V.
Petroleum, chemical and petrochemical plants, power station & complex industrial plants.
The Hague: Surinamestraat 34.
The Hague: De Ruyterstraat 48. Wishart, mgr.

VAN OORTMERSSEN, N.V.
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).

WYNMALEN & HAUSMANN V.V.
Dist., Bucyrus-Erie (drills, construction machinery).
Rotterdam.

A. BRUYAUX, N. V.
Dist., Dresser Mfg., (couplings, pipe clamps, sleeves).
Amsterdam: Singel 374.

TOLLENS & CO.
Dist., DuPont Co., (finishes).
Rotterdam — W: Box 6039.

NV INTER'L CREDIET-EN HANDELS-VER
Dist., DuPont Co., (petroleum chemicals).
Rotterdam: Technical Dept., Inland Sales Sec. Box 567.

ANIMEX N.V.
Dist., DuPont Co., (photo products).
Haarlem: Nieuwe Gracht 7.

MACK TRUCK NEDERLAND
Trucks.
Hilversum: 32, Larenseweg.

UNITED CENTRIFUGAL PUMPS OF NETHER.
Centrifugal pumps.
The Hague: Cornelis Jolstraat 1 Scheveningen. tel. 550941. UNIPUMP. Anton Bos, mgr.

BARTON-EUROPA
Twin bellow flow meters.
The Hague: Zonweg 41. Tel. 779874.

BRYON JACKSON, N.V.
Rotary tongs, tubing hooks & catchers.
Etten, North Brabant: Box 25. Tel. Etten en Leur, 01608-894. BYJACNV. Earl M. Rees, mgr.

COMPRIMO
Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction); Vapor Recovery (equipment related to storage & transportation of liquids).
Amsterdam: Amstel 21. Box 688. COMPRIMO.

N. V. PROFILTRA
Dist., Johns-Manville (industrial insulation materials).
Amsterdam: Leidsegracht 36. Tel. 36581-37446. PROFILTRA. L. Benjamins, dir.

GROOTHANDELSGEBOUW
Dist., Oakite (cleaning & descaling compounds).
Rotterdam: Postbus 73. Rogier Bosman, mgr.

KONINKLIJKE MACHINEFABRIEK GEBR. STORK
Dist., Pacific Pumps, (pumps).
N. V. (VMF) Hengelo (O).

LUMUS NEDERLAND N.V.
Refinery construction.
The Hague: 56 Schevingseweg. S. Van Kutzeben, mgr.

MARTHINSEN SHIPPING
Dist., Petrolite Corp., (Tretolite metal conditioner & tank cleaners).
Rotterdam: Groothandelsgebouw A IV. Tel. 11.80.25. MARSHIPCOL, R. Marthinsen, mgr.

VAN DUYL'S MACHINEHANDEL
Dist., Norton Behr-Manning (porous mediums, catalyst carriers, bricks, cements).
Rotterdam: Jufferstraat 13-17.

ORANJEBERG, M.V.
Dist., T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).
The Hague: Stationsweg 141. Tel. 113326. ORANJEBERG STATIONSWEG 141.

PETROLITE CORP.
Tretolite chemical demulsifiers, desalters, corrosion inhibitors, paraffin removers, Petreco electric desalting, dehydrating, etc.
The Hague: Hoefbladlaan 134. Tel. 39-68-83. F. E. Jenkins, mgr.

R. S. STOKVIS & ZONEN N.V.
Dist., Beryllium (copper rod alloys, casting ingots); Branson (ultrasonic gaging, cleaning).
Rotterdam: Box 426. STOKVISZON. Ferrous Dept.

TECHNISCH BUREAU EEKELS
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Amsterdam W: Sloterweg 141.

TECHNISCH BUREAU WEST
Dist., Barton (twin bellow flow meters); Westinghouse Air Brake, (pneumatic controls for oil industry, hydraulic surge dampening).
The Hague: Zonweg 41. Tel. 728712.
Den Haag: Weteringplein 21. (Westinghouse).

VAN ROOY DORSMAN N.V.
Dist., Aeroquip (hydraulic & aviation equipment).
Amsterdam: Reguliersdworssiraat 108-114.

N. V. EMBA AGENTUREN
Dist., Shand and Jurs (gages & indicators, safety equipment for storage tanks, automatic level remote control equipment, data-logging).
Rotterdam: Industriegebouw Goudsesingel 204-206.

CRANE CARRIER CONTINENTAL
Trucks.
Rotterdam: 9-11 Rivierstraat. Tel. 12 66 91. CRANECAR.

FIRMA WEBER
Dist., Mid-Western Pipe Line Products, (pipe wrapping materials).
Rotterdam: Marniersweg 151. Tel. 120113 (4 lijnen). SUPERHEATED. H. K. Weber, mgr.

METCO NETHERLANDS N.V.
Dist., Metallizing Engineering (metallizing equipment, wires).
Amsterdam: Keizersgracht 503. Will Smit, mgr.

REED ROLLER BIT CO.
Rock bits, tool joints, drill collars, coring equipment.
LEIDEN: Roosevelt Straat 6. Tel. 3—2246. REEDBIT.

N.V. BUR. VOOR ECONOMISCHE STOOMPRODUCTIE
Dist., Dewrance & Co. (steam traps, strainers).
Rotterdam: Admiraliteitskade, 75.

NEW ZEALAND

GILBERT LODGE & CO.
Dist., Continental-Emsco (drilling and producing equipment).
Wellington: 27 Rutherford. Box 20, Lower Hutt. GILBERTLOJ.
New Market: 24 Great South Road. Box 9194. GILBERTLOJ. M. M. Mahaffey, mgr.
Christchurch: 16 Mortimer Pl. GILBERTLOJ. Mr. Burt, mgr.

MASON BROS. ENG. COY, LTD.
Dist., Modern Eng. (oxy-acetylene welding and cutting apparatus and supplies).
Auckland: 29-31 Anzac Ave. Box 3485.

JAMES J. NIVEN & CO.
Dist., Geo. F. Failing, (drilling rigs).
Wellington: 65-67 Tarrnaki St.

A. M. SATTERTHWAITE & CO.
Dist., Oil Well Supply, (oilfield supplies).
Christchurch: 203 Hereford St.

SCOLLAY, WM. & CO.
Dist., Beryllium (copper rod alloys & casting ingots.)
Wellington C. 1: Box 2377.

ANDREWS & BEAVEN
Dist., Aeroquip (hydraulic & aviation equipment).
Christchurch: Box 138.

DOMINION MOTORS, LTD.
Dist., National Supply (oilfield supplies).
Wellington, C. 3: 59 Courtenay Place. Box 599. Tel. 56-290. WOODNORD.

HARGRAVE, J. F., LTD.
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Wellington: 92-94. Jervois Quay.

MAGNATROLE
Liquid level controls, boiler water level controllers, flow alarm switches.
Wellington: Box 1783.

NICARAGUA

AUTO. & INDUS. EQUIP.
Dist., Columbian Steel Tank, (storage and truck tanks).
Managua: Apartado 323. AUTOMOTIVE. J. Sengelmann, mgr.

CASA COMMERCIAL McGREGOR
Dist., Marmon-Herrington Co. (Fords).
Managua: Apartado 448. McGREGOR. Albertina McGregor, mgr.

A. SOMOZA H. Y CIA
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Managua: Apartado Postal 67.

M. J. RIGUERO & CIA
Dist., DuPont Co. (photo products).
Managua: Apartado 308. Avda. Roosevelt 303.

NICARAGUA MACH. CO. S.A.
Dist., DuPont Co. (explosives).
Managua: Apartado 469. Primera Calle S.O. 109.

J. CARDENAL HIJO & R. LACAYO FIALLOS & CIA.
Dist., DuPont Co. (finishes).
Managua: Apdo. 621. 1A Ave. S.E. 307.

A. S. HARRISON & CO.
Dist., DuPont Co. (elastomers).
Wellington: 120 Wakefield St. Box 2444.

NORWAY

A/S PROTON
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Oslo: Rosenkrantzgaten 11.

WITT & BORGEN
Dist., Shand and Jurs (General Precision), (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, data-logging).
Oslo: Ovre Vollgt. 6.

C. FRIMANN-DAHL A/S
Dist., DuPont Co., (finishes).
Oslo: Dronningensgt 10-12.

OTTO FALKENBERG A/S
Dist., DuPont Co., (polychemicals).
Oslo: Maridalsvn. 31 B.

ENGEBY, TRYGVE M. A/S
Dist., DuPont Co., (photo products).
Oslo: Jernbanetorget 4. Box 893.

LAURITZEN & THOMMESEN
Dist., Aeroquip (hydraulic & aviation equipment).
Oslo: Chr. Krohgsgt 32.

NORMAJERN A/S
Dist., Beryllium (copper rod alloys & casting ingots).
Oslo: Box 529.
Bergen: Box 713.

VENDITOR A/S
Dist., Chiksan Export (swing joints, steel rotary hose, circulating heads, mud guns, reamers, fittings, etc.).
Ski: Tel. 513. D. Johansen, mgr.

PANAMA

EMPRESAS PANAMENAS
Dist., Geor. F. Failing, (drilling rigs).

Panama: Ave. 11, 29-16. Box 3348, Estateta 1.
F. ICAZA & CIA.
Dist., Black, Sivalls & Bryson, (oilfield equipment).
Panama: Box 2140. FISCA.
NAVARRO & MACMURRAY
Dist., Armstrong Machine Works, (traps, strainers).
Panama: Ave. Cuba, Entre Calles 25 & 26.
GUARDIA & CO. S.A.
Dist., DuPont Co., (finishes, photo products).
Panama City: Apartado 481. Justo Arosemena Ave. & 29th St.
ISAAC BRANDON & BROTHERS
Dist., DuPont Co., (explosives).
Panama City: Apartado 387. 5-36 Eight St.
AGENUAS HAGUS, S.A.
Dist., Aeroquip (hydraulic & aviation equipment).
Panama City: Ave. 7a, Central 16-14.
CARDOZO & LINDO, S.A.
Dist., Aeroquip (aviation & hydraulic equipment).
Panama City: Box 112.
CURTIS-WRIGHT
Dist., Curtis-Wright, (alloy steel pressure pipe).
Panama City: Box 923. George P. Novey, mgr. NOVEY.

PAKISTAN

GEOPHYSICAL SERVICE INTERN'L.
Seismic, gravity, magnetic surveys & seismic data processing services.
Dacca: Box 53. Tel. 4060. J. R. Hughes, supvsr.
RALPH M. PARSONS CO.
Dacca: Box 129. PARSPAKAN. Ralph W. O'Neill, mgr.
Karachi: Box 3903. Tel. 7-741. Col. John E. Soule, mgr.
NOOR MOHAMED & SONS LTD.
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Karachi: Bunder Road.
MACNEILL & KILBURN, LTD.
Dist., Dewrance & Co. (steam traps, strainers).
Karachi: 2. Hakimsons Bldg., No. 1 West Wharf Rd. Box 4864.

PARAGUAY

RURAL INDUSTRIAL & COM.
Dist., Columbian Steel Tank, (truck-tanks, storage tanks, hoses).
Asuncion: Av. Gral Artigas No. 230. Casilla de Correo 511. SARIC. Tel. 258.
SOCIEDAD ANONIMA COMMERCIAL
Dist., Black, Sivalls & Bryson, (oilfield equipment).
Asuncion: Casilla de Correo 573. NOLO. Manuel Ferceira, mgr.
OSCAR S. NETTO S/A
Dist., Mack Trucks.
Asuncion: Eligio Auala & Mexico. NETTOSCAR.
ASTILLEROS SAN JOSE BOZZANO & CIA
Dist., Baker Oil Tools (technical advice).
Asuncion: Cnel. Martines 60. Box 753. COPER. Jorge A. Bozzano, mgr.

PERU

CUSTER & THOMEN
Dist., Infilco Inc. (Industrial filters); Aeroquip (aviation & hydraulic equipment).
Lima: Casilla 733. Tel. 74280. CUSTHOMSA. J. A. Geser, mgr.
GEOPHYSICAL SERVICE INTERN'L.
Seismic, gravity, magnetic surveys & seismic data processing services.
Lima: Avenida Tacna 329 Oficina 301. 302. D. W. Rockwell, opera. mgr.; M. V. Linwell, supvsr.
GROSS EQUIPMENT
Dist., Axelson Division,(plunger pumps and sucker rods); Jet-Lube (thread compounds for drill collars, tool joints, casing & tubing, oilfield grease specialties); Gross Chiksan Export (wing joints, steel rotary hoses, circulation heads, mud guns, reamers, disc bits, etc.) Web Wilson (drilling tools); U. S. Industries (stocks seats & balls & packing).
Lima: Ocona 160, Apartados 677 V 1869.
INTER-CONTINENTAL TRADE
Dist., Continental-Emsco, (drilling and producing equipment).
Lima: Casilla 2657. Tel. 32206. ICONSA. Lius P. Navarro, pres.
INTERNATIONAL GAS LIFT
Dist., Oil Metering & Processing, (crude oil metering, equip.); Lane Wells (technical oilfield services, perforating, well logging, packers); Kimray, Inc. (regulators, control valves, temp. controllers, oil & gas equipment, controls); Clark Bros. — Dresser Industries (compressors, engines, gas turbines); Cardwell (portable rigs, winches, hoists, masts & drawworks); Petrolite Corp. (Tretolite chemical demulsifiers, desalters, corrosion inhibitors, etc.); Barton Instrument (twin bellow flow meter).
Talara: Apartado 71. INTERLIFT. John V. Herasimchuk, mgr. Tel. Negritos 222-76.
SERVICIOS PETROLEROS
Dist., Oil Base (field engineering service); Garrett Oil Tools (gas lift equipment, motor valves & controllers, etc.); Cabot Shops & Franks Div. (pumping units); Cameron Iron Works (blowout preventers, Xmas trees, valves, instruments); Bowen Itco. (fishing tools, rotary jars, wire line pressure control); Security Inter'l. — Dresser Industries (valves, alloys, rock bits).
Lima: Apartado 1079. Tel. 3-3877. Plaza San Martin 938-302. SERPET. Stanley Parfet, mgr.
SOCIEDAD QUIMICO INDUSTRIAL
Dist., Modern Engineering, (oxy-acetylene welding and cutting apparatus and supplies).
Lima: Cassilla de Correo 1914. Edwardo Dibos Ch., mgr.
A. y F. WIESE
Dist., Oil Well Supply, (oilfield supplies); Black, Sivalls & Bryson, (oilfield equipment).
Lima: Wiese Bldg. Box 2793. WIESE.
PERUVIAN TRADING CORP.
Dist., Rockwell (valves, meters, regulators); Southwestern Ind. Electronic — Dresser Industries (seismograph equipment); Baker Oil (technical advice); Oakite (cleaning & descaling compound); Shaffer Tool (blowout preventers, flow beans, casing heads, control gates, drilling equipment, etc.).
Lima: Casilla 1537. Lampa 659. Tel. 72-338 & 72-339, PRUTRADING. Gonzalo Otero Lora, mgr.
JOY MFG. CO.
Dist., Baash Ross (drilling & production equipment).
Lima: Casilla 3111. S. F. Coats, mgr. Tel. 42350. JOYLOADER.
ARMCO PERUANA, S.A.
Dist., National Supply (oilfield supplies).
Lima: Nicolas de Pierola 938. Plaza San Martin. Casilla Correo 374. ARMCO. Tel. 42225.
BUONANNI, OSVALDO
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Lima: Casilla 223.
SUMINISTROS INDUS. S.A.
Dist., W. H. Curtin (Lab apparatus, petroleum testing equipment & reagent chemicals).
Lima: Camana 615. Oficina 405. Tel. 40-141. SUMINDU. Alfredo Munoz R., mgr.
A Y F WIESE, S.A.
Dist., American Iron & Machine (packers & overshots).
Talara: Apartado 90. Luis Arata V., mgr.
REDELSA, S.A.
Dist., Vapor Recovery System (equipment related to storage & transportation of liquids).
Lima: Casilla 1046. Tel. 3-8361. REDELSA. Ave. Grau 286. Thomas H. Heine, dir. mgr.
E. R. POOLE
Dist., Ideco-Dresser Industries (drilling rigs, drilling & producing equipment).
Lima: Oficina 75. Ave. Tacna 338. Tel. 42-418. POOLE.
DUPONT PERU, S.A.
Dist., DuPont Co. (photo products, petroleum chemicals, poly chemicals, finishes, elastomers).
Lima: Apartado 2787. Av. Tachna 592. Oficina 111.
SR. ERNESTO DE ROSSI
Dist., DuPont Co. (explosives).
Lima: Apartado 1079.
LA COMERCIAL IMPORTADORA
Dist., Mack Trucks.
Lima: Ave. Bolognesi 125.
ENRIQUE FERREYRAS & CIA.
Dist., Yarnall-Waring (blow-off valves, water gages, liquid level indicators, expansion joints, steam traps, strainers).
Lima

PHILIPPINES

ATLANTIC, GULF & PACIFIC
Dist., Continental-Emsco (drilling and producing equipment).
Manila: Box 626. Tel. 3-36-61. DREDGING. B. B. Fischer, mgr.
G. A. MACHINERIES, INC.
Dist., Marmon-Herrington, (Mercurys).
Manila: Box 3161. GANDUM NABUKA. Vincente A. Araneta, pres.
MODERN PHARMACAL PRODUCTS
Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Manila: 922-928 Rizal Ave.
PICSPA CORP.
Dist., Well Instrument Dev., (electric well logging equipment).
Manila: El Hogar Filipino Bldg. Box 610. PICSPA. Tel. 3-94-81. L. R. Moran, mgr.
UNICO TRADING CO.
Dist., Modern Engineering, (oxy-acetylene welding & cutting apparatus, supplies).
Manila: 484 Rosario St. Box 2594. UNICOTRA.
U. S. AUTOMOTIVE CO.
Dist., Tulsa Winch, (winches power take-offs, speed reducers, transmissions).
Manila: Issac Peral Corner. San Marcelino St.
PHELPS DODGE COPPER PROD.
Copper wire & cable, brass pipe & tube.
Manila: Soriano Bldg. PHELPDODGE. Col. Lee A. Telesco, mgr.

YUTIVO SONS HARDWARE CO.
Dist., Beryllium (copper rod alloys & castings ingots).
Manila
MACCONDRAY & CO., INC.
Dist., DuPont Co. (finishes, polychemicals, photo products, explosives, elastomers).
Manila: Box 768.

PORTUGAL

SOCIEDADE INDUS. ARGO-REPARADORA
Dist., Hercules Motor (Hercules & Hall-Scott gasoline & diesel engines, Lycoming air cooled gasoline engines.)
Lisbon: 80-B, 80-E, Avenida Almirante Reis. R. Morato Rodrigues, mgr.
LOUIS GOTTSCHALK
Dist., Eastman Oil Well Survey (directional drilling, oil well surveying, star recorders).
Lisbon: Apartado 775.
VENDOR, LTDA.
Dist., Eastman Oil Well Survey, (directional drilling, oil well surveying, Star recorders).
Lisbon: Travessa da Gloria. B. Hermanson, mgr.
AGENCIA TECNICA DE MAQUINAS
Dist., National Supply (oilfield supplies).
Lisbon: Rua de Sao Paulo, 90-1°. Tel. 20386. OTAR.
COMAPRO
Dist., Security Inter'l.-Dresser Industries (valves, alloys, rock bits).
Lisbon: Rua Rodrigues Sampaio 21-3. O.A.
VENDOR
Dist., Oakite (cleaning & descaling compounds).
Lisbon: Travessa da Gloria 19. Bo Hermanson, mgr.
LIMA MAYER & CIA
Dist., DuPont Co. (explosives).
Lisbon: 59 Rua da Prata.
CARLOS GOMES & CA.
Dist., DuPont Co. (elastomers).
Lisbon: Rua Dos Fanquieros 15.
FRANCISCO PIRES DIAS
Dist., DuPont Co. (photo products).
Lisbon: Rua Augusta 193-3.
BETHENCOURT BROTHERS
Dist., DuPont Co. (finishes).
Lisbon: Rua Aurea 132-138.
SOC. ESPANOLA DE CON. BABCOCK & WILCOX
Dist., Dewrance & Co. (steam traps, strainers).
Lisbon: 78, Praca dos Restauradores.
SAN MIGUEL & CO.
Dist., Yarnall & Waring (blow-off valves, water gages, liquid level indicators, expansion joints, steam traps, strainers).
San Juan

PUERTO RICO

CEA INDUS. SUPPLY
Dist., Amercoat Corp. (protective coatings, vinyls, epoxies, Dimetcote).
Santurce: Box 9682.
ESCUDERO & FRANCESCHINI
Dist., Mexico Refractories, (refractory castables, mortars, ramming materials, firebrick).
San Juan: Condado 613. Box 3784. Tel. 2-4634. Mario Franceshini, mgr. JORGERO.
SAN MIGUEL & CO.
Dist., Modern Engineering, (oxy-acetylene welding & cutting apparatus supplies).
San Juan: 151 Tetuan St.
MIGUEL MORALES
Dist., Yuba Consolidated Ind., (heat exchanger, expansion joints).
San Juan: 329 Recinto Sur (9). Box 208. Tel. 2-2544. Miguel Morales, mgr.
WEST INDIA MACH. & SUP.
Dist., Hercules Motors, (Hercules & Hall-Scott gasoline & diesel engines, Lycoming gasoline engines); D. W. Onan & Sons (electric plants, generators, air-cooled engines).
San Juan: Box 2432. R. W. Garffer, pres.
MARTINEZ & MARQUEZ
Dist., Carrier Corp. (air conditioning, heating, refrigeration).
San Juan: Box 3548. Labra & Carmen St. MARTIMACO. Tel. 3-2282.
GARCIA MACHINERY
Dist., LeTourneau-Westinghouse, (construction machinery).
San Juan: Calle Labra 800. Box 3368. GARMAC.
ISLAND SUPPLY CO.
Dist., Rockwell (valves, meters, regulators); Beryllium (copper rod alloys, casting ingots).
Ponce: Box 951.
PORTILLA CORP.
Dist., Clark Bros.-Dresser Indus. (compressors, engines, gas turbines).
San Juan: Box 3334.
LUIS F. CARATINI & SON
Dist., Dresser Mfg. (pipe couplings, clamps, sleeves, etc.).
San Juan: Apartado 2184.
FERNANDEZ & CO.
Dist., Aeroquip (hydraulic & aviation equipment).
San Juan: Tetuan St. No. 152.
GARCIA MACHINERY INC.
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
San Juan: 15, Box 3368.
IND. COATINGS & DETERGENTS
Dist., Oakite (cleaning & descaling compounds).
Santurce: Apartado 2491. Wilson 1356.
INDUS. SUPPLY CO.
Dist., W. H. Curtin (lab apparatus, petroleum testing equipment, reagent chemicals).
San Juan: Box 65. Tel. 2-3013. Don Agnew, mgr. INSUCO.
PHELPS DODGE COPPER PRO. INTER'L.
Copper wire & cable, brass & copper pipe & tube.
Miramar (San Juan): Suite 201, 804 Ponce de Leon Ave. Temp. Tel. 2-0569. Francis Hekking, mgr. PHELPDODGE.
RODRIGUEZ, JULIO T.
Dist., Appleton Electric (unilets, flood lights, controls).
San Juan: Box 1325. JUROD.
ROONEY PHOTO MART, INC.
Dist., DuPont Co. (photo products).
Santurce: 1460 Ponce de Leon Ave. Herbert Rooney, mgr.
A. OSCAR RIVERA, INC.
Dist., DuPont Co. (polychemicals, elastomers).
San Juan: Box 4032.
E. LEON & CO. INC.
Dist., DuPont Co. (explosives).
San Juan: Box 2884.

SAUDI ARABIA

CONTRACTING & TRADING
Dist., Bowen Itco, (fishing tools, rotary jars, wire line pressure control).
Dammam: Box 187. CAT. Emile Bustani, mgr.
GEO. SERVICE INTER'L.
Seismic, gravity, magnetic surveys.
Dhahran: Box 2348. T. A. Garvey, supvsr.
HAMAD AHMAD ALOGOSAIBI & SONS
Dist., Arco Co., (paints and protective coatings).
Alkhobar: Box 106.
Riyadh: Box 86. c/o E. A. Juffali & Nros., Richard S. Davis, rep.
HAJI ABDULLAH ALIREZA
Dist., Marmon-Herrington, (Fords).
Djeddah: Box 8. ZAINALREZA. Sheikh Ahmed Y. Z. Alireza, mgr.
SAUDI COM. & IND.
Dist., Carrier Corp., (air conditioning, heating, refrigeration).
Jeddah: Baghdadieh St. Box 349. BARED.
TUBOSCOPE CO.
Inspection, (oilfield tubular goods).
Abqaiq: Box 462. C. W. Jacobs, mgr.
SALIM MOHAMED SUWAIKAT & BROS.
Dist., Arco Co. (paints & protective coating).
Alkhobar: SUWAIKAT.
ARABIAN TRADING CO.
Dist., Bucyrus-Erie (drills, construction machinery).
Jeddah

SOMALIA

ROGERS EXPLORATIONS
Seismograph contractor, magnetometer.
Mogadiscio: Box 4. ROGEXCO. J. R. Robbins, mgr.

SPAIN

HERCULES MOTORS IBERICA
Hercules & Hall-Scott gasoline & disesel engines, Lycoming gasoline engines.
Madrid: Toledo, 94. Andre Conde Medin.
GUMERSINDO GARCIA
Dist., LeTourneau-Westinghouse, (construction machinery).
Madrid: 3 Martinez Campos St. Apartado 731. INGE.
AUTO-ELECTRICIDAD
Dist., Carrier Corp., (air conditioning, heating, refrigeration).
Madrid: C. Coello 85. AUTOBAT. Tel. 36 33 10.
MAQUINARIA
George F. Failing, (drilling rigs).
Madrid: Marques Del Riscal, 2. Apartado 45.
SUMINSTROS CONTINENTAL
Dist., Continental-Emsco, (drilling and producing equipment).
Madrid: Hotel Castellana Hilton. Tel. 57. 22 00. PARACLOSE. Capt. Forrest Close, mgr.
VEGARADA, S.A.
Dist., Well Instrument Develop., (electric well logging equipment).
Madrid: Avda. Generalisimo 8. Tel. 330062. NOCEDO. Jose M. Rosales, mgr.
ANGLO-ESPANOLA DE ELECTRICIDAD, SA
Dist., Young Radiator (heat transfer products); W. H. Curtin (lab apparatus, petroleum testing equipment, reagent chemicals).

Barcelona: 11, Av. Jose Antonio 525. Tel. 24-38-00. Royston St. Noble, Mgr.

MASSO Y CAROL, S.A.
Dist., DuPont Co. (petroleum chemicals, elastomers).
Barcelona: 13, Caspe 130.

J. MAS NIETO
Dist., DuPont Co. (photo products).
Barcelona: 13, Caspe 89.

LA ACEITERA EXPORT, S.A.
Dist., DuPont Co.
Barcelona: 'Sans'. Plaza Vazquez Mella.

H. DETRAUTTENBERG
Dist., Engelhard Ind. (petroleum catalysts).
Madrid: Av. Calvo Sotelo, 18.

IMPEX, S.A.
Dist., Insley (trench hoes, excavators, cranes).
Madrid: Alcala 63.

INDUSTRIAS SUBSIDIARIAS DE AVIACION, S.A.
Dist., Aeroquip (hydraulic & aviation equipment).
Seville: Apartado 250. San Jeronimo.

WAID, ROBERT T.
Dist., Martin Decker (indicating & recording drilling control instruments); National Supply (oilfield supplies). (Maquinaria, Sociedad Anonima).
Madrid: Apartado 45. Marques Del Riscal, 2. Tel. 23-95-02. ROWAID.

PAUKNER
Dist., T. D. Williamson (tapping machines, stopples, pigs, casing seals, insulators).
Madrid: Paseo de la Castellana. Tel. 230358 & 230525. A. Paukner, mgr.

PIPER, LINN T.
Dist., Vapor Recovery System (equipment related to storage & transportation of liquids).
Madrid: Gta., Ruben-Dario 1. Tel. 241344. LINPIPER.

SUMINISTROS "SHAG" SA
Dist., Indeco-Dresser Industries (drilling rigs, drilling & producing equipment).
Madrid: Av. Menendez Pelayo 2. Tel. 35-08-00. SUSAG.

WESTINGHOUSE DE FRENOS Y SENALES
Pneumatic controls for the oil industry, hydraulic surge dampening.
Madrid: 68 Av. Jose Antonio. L. Tortosa, mgr.

WORTHINGTON, S.A.
Air conditioning, heating, refrigeration, pumps, compressors, etc.
Madrid

JACKSON, L. E.
Dist., Clark Bros.-Dresser Industries (compressors, engines, gas turbines).
Barcelona: Plaza Cataluna 21, 3°.
Madrid: Juan Brazo 25, 2°.

GUMERSINDO GARCIA SA
Dist., Bucyrus-Erie (drills, construction machinery).
Madrid

SOC. ESPANOLA DE CONSTRUCIONES BABCOCK & WILCOX
Dist., Dewrance & Co. (steam traps, strainers).
Bilbaco: 1 Calle Ercilla.

SWEDEN

A. B. CONSOLIT
Dist., George F. Failing, (drilling rigs).
Stockholm: Kungsholms. Hamnplan 2.

ANGLO-NORDIC TRAKTOR
Dist., LeTourneau-Westinghouse, (construction machinery).
Stockholm: Sturregatan 5. NORDICTRAKTOR.

INGENIORSFIRMAN BELOS
Dist., Shand & Jurs-GP sub. (safety equipment for storage tanks, automatic level gages & indicators, control equipment).
Stockholm: Alviksvagen 30. Tel. Vaxel 26 15 02, 26 15 03. BELOSAB.

LKB-PRODUKTER
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive chemicals, consulting service, isotope applications).
Stockholm: Fabriksaktiebolag, Box 12035.

A/B LORENTZEN WETTRES MASKINAFFAR
Dist., Amercoat, (protective coatings, vinyls, epoxies, Dimetcote).
Stockholm: Drottninggattan 49.

BIRGER CARLSON & CO. A.B.
Dist., Roots-Connersville-Dresser Industries (blowers, meters, blower vacuum pumps).
Stockholm O: Kaptensagatan 6.

DULAC, A.B.
Dist., DuPont Co. (finishes).
Stockholm: Stureplan 4.

AMERIKANSKA FILMIMPORTEN
Dist., DuPont Co. (photo products).
Stockholm: Norrlandsgatan 18.

ELOF HANSSON
Dist., DuPont Co. (petroleum chemicals, poly chemicals).
Goteborg C: Vasagatan 34.

HENRIK GENBERG
Dist., DuPont Co. (elastomers).
Goteborg C: O. Hamngatan 19.

AKTIEBOLAGET SPECIALPUMPAR
Dist., Chiksan Export (swing joints, steel rotary hose, circulating heads, mud guns, disc bits, etc.)
Goteborg: Ostra Hamngatan 24. Tel. 13-14-89 & 11-55-91. SPECIAPUMP. E. Bjerg Mortensen, mgr.

AKTIEBOLAGET WIRO—17.
Dist., Aeroquip (hydraulic & aviation equipment).
Stockholm: 6. Ynglingagaatan 17. Box 6068.

EDSTROM TRADING CO. AB
Dist., Beryllium (copper rod alloys, casting ingots).
Stockholm: Kungsgatan 33.

KEMISKA AB CANDOR
Dist., Oakite (cleaning & descaling compound).
Fittja: S. Gramberger, mgr.

INGENJORSBYRAN GUNNAR SALWEN
Dist., Branson Inst. (ultrasonic gaging & cleaning equipment, flaw detectors).
Halmstad: Kungsgatan 1. SALWEN.

INGENJORSFIRMAN BERTIL OSTBO AKTIEBOLAG
Dist., Curtis-Wright (alloy steel pressure pipe).
Sodertalje: Postgiro 330759. Tel. 0755-39900. Karl Erik Erikson, mgr. INGBOLAC.

INGENJORSFIRMAN REGULA, AB
Dist., Mangetrol Inc. (liquid level controls, boiler water level controllers, flow alarm switches).
Sodertalje: Hertig Carls Vag 20-B. Artur Monsen, mgr.

A. B. KIHLSTROMS MANOMETERFABRIK
Dist., Barton Inst. (twin bellow flow meters).
Stockholm: Malmagardsvagen 63. Tel. 23-22-05.

SWITZERLAND

A. SCHUBARTH & CO.
Dist., Shand & Jurs-GP sub. (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, data-logging).
Basle: Peter Merian—Str. 45.

OSWALD E. BOLL
Dist., Amercoat Corp., (protective coatings, vinyls, epoxies, Dimetcote).
Zurich: Seefeldstrasse 45.

BRINKHOFF JAHN
Dist., Vermeer Mfg., (ditchers).
Zurich: 16 Ottenweg. F. Brinkhoff, mgr.

KERN & CO., LTD.
Surveying & engineering instruments, drafting instruments, binoculars, polarimeters, telescopes.
Aarau: (064) 2 11 12 BENTLEY'S RUDOLF MOSSE, Dr. Paul Vogel, commerc. dir.

PERKIN-ELMER
Infrared spectrophotometers, vapor fractometers, process control.
Zurich: Scheuchzerstrasse 7 Tel. 26 75 26. PERKINELMER. George G. Zahler, mgr.

PETROLEUM & MINING EQUIP.
Dist., Continental-Emsco, (drilling and producing equipment); Guiberson Corp., Dresser Industries, (oilfield equipment, molded rubber products).
Geneva: 3 Rue de la Cite. Tel. 245365. A. G. Chandler, mgr. PETROMINE.

VITRO INTERNATIONAL
Dist., Refinery Engineering Co., (coking units).
Geneva: 64 Rue du Stand. Tel. 26-40-20. VITROWORLD. Ralph L. Brown, vice pres.

SIFRAG
Dist., Carrier Corp., (air conditioning, heating, refrigeration).
Zurich: 3 Ankerstrasse. SIFRAG. Tel. 25 15 51.

SIE DIVISION OF DRESSER AG
Dist., Southwestern Ind. Electronics (seismograph equipment).
Zurich: Muehlebachstrasse 43.
Zurich: Seyffer & Co.

GARWOOD, T.G.
Dist., Otis Engineering (specialized oilfield equipment).
Geneva: 3 Rue de la Cite. Tel. (office) 24-53-65 & (home) 36-30-78. PETROMINE.

AUTOLAC, S.A.
Dist., DuPont Co. (finishes).
Zurich: Kronenstrasse 37.
Geneva: 18 Rue du Pre-Jerome.

OMAG
Dist., DuPont Co. (photo products).
Neuallschwil: Spitzwaldstrasse 145.

DUPONT DE NEMOURS INTER'L.
Elastomers, polychemicals.
Geneva: 6 Rue de la Rotisserie.

BUBECK & DOLDER
Dist., DuPont Co. (polychemicals, elastomers petroleum chemicals).
Basle: 4. Isamengasse 7/9.

ESCHLER-URANIA ACCESSORIES
Dist., Aeroquip (hydraulic & aviation equpiment).
Zurich: Badenerstrasse. 292-96.

ISELI, HENRY C.
Dist., Hills-McCana (diaphragm valves, chemical, meter & proportioning pumps).
Oberengstringen-Zurich

S. KISLING & CIA, AG
Dist., Beryllium (copper rod alloys, casting ingots).
Zurich: Box 22.

HANS KOHLER A.G.
Dist., Curtis-Wright (alloy steel pressure pipe).
Zurich: Claridenstrasse 20. Tel. (051). 23-01-10. EISENKOHLER. Hans Kohler, mgr.

MUHLENEN, N.V.
Dist., Oakite (cleaning & descaling compounds).
Bern: Schlosstrasse 131.
REFRACTON, A.G.
Dist., Norton Behr-Manning (porous mediums, catalyst carriers, bricks, cements).
Zurich: Genferstrasse 2.
SELAS CORP. EUROPEAN DIV.
Tubular furnaces for continuous processing, burners, dehydrators.
Geneva: 10 Chemin de l'Imperatrice. Tel. (022) 34-4510. SELASTHERMIC. W. Jack Hofmann, mgr.
SOC. ANONYME DES FREINS ET SIGNAUX WESTINGHOUSE.
Pneumatic controls for oil industry, hydraulic surge dampening.
Berne: 35 Effengerstrasse. K. De Wurstemberger, mgr.

SYRIA

CONTRACTING & TRADING CO.
Dist., Bowen Itco. (fishing tools, rotary jars, wire line pressure control).
Damascus: Al Fardos St. Box 717. CAT. Tel. 11636.
Homs: Damascus Road, Box 43. CAT. Tel. 1230.
GENERAL AUTO AGENCY LEVANT
Dist., Marmon-Herrington. (Fords).
Damascus: El Mouradi St., Box 362. Tel. 14191. NAMAN. Beshara Naman, mgr.
SYRIAN IMPORT, EXPORT & DIST.
Dist., DuPont Co. (finishes).
Latakia: Box 4.
Damascus: Box 363.
Aleppo: Box 581.

THAILAND

MECHANICAL EQUIPMENT CO.
Dist., Baldwin-Lima-Hamilton Corp., (cranes, crawler, wheel & truck mounted, Black, Sivalls & Bryson, (oilfield equipment).
Bangkok: 295 Siphya Road. Box 550. Tel. 31331, 31332, 32037. LIMA-SHOVEL. R. G. Carter, mgr.
D. COUPER-JOHNSON & CO.
Dist., George F. Failing, (drilling rigs).
Bangkok: Box 51.
INTERNATIONAL ENGINEERING
Dist., Lane Wells, (technical oil field services, perforating, well logging, packers).
Bangkok: Box 39, Chartered Bank Lane. GYSOM.
RUAM-JAI CO.
Dist., Marmon Herrington Co. (Fords)
Bangkok: 1177 Bangkok Smutprakarn Rd. Tel. 56374. RUAMJAICO. Sampow Sirisambhand, mgr.
UNITED MACHINERY CO.
Dist., Columbian Steel Tank, (truck tanks).
Bangkok: 412-414 Worachakr Road. Tel. 21163. UMAC. C. Chittkusel, mgr.
EASTERN INTER'L. DEV. CORP.
Dist., Insley (trench hoes, excavators, cranes).
Bangkok: Mansion 1 Rajadamnern Ave.
TANARAK CO., LTD.
Dist., Rockwell (meters, regulators, valves).
Bangkok: 14 Sub-Road Siphya.
SIAM ARCHITECTS "IMPORT"
Dist., DuPont Co. (photo products).
Bangkok: 119 Asdang Rd.
BORNEO CO., LTD.
Dist., DuPont Co. (elastomers, polychemicals, finishes).
Bangkok: Import Depart. Silom Road.

TRINIDAD

BARYTES & MINERALS LTD.
Dist., Baroid Div. National Lead (drilling mud products and services, mud analysis well logging).
Port of Spain: 59 Sackville St. Tel. 3-1566. BARMINE. W. H. Busold, mgr.
BROWN & ROOT OVERSEAS
Engineering, design, project management, construction, maintenance services.
Port of Spain: 11 Windsor Road, Goodwood park. BROWNBILT. H. R. Powell, mgr.
H. J. GRANSAUL & CO.
Dist., Jet-Lube, (thread compounds for drill collars, tool joints, casing & tubing, oilfield grease specialties); Cameron Iron Works, (blowout preventers, Xmas trees, valves, instruments); Web Wilson (drilling tools); Aeroquip (hydraulic & aviation equipment); Martin-Decker (indicating & recording drilling control instruments).
San Fernando: Box 98. Tel. 3286.
J. N. HARRIMAN & CO.
Dist., Continental-Emsco, (drilling and producing equipment).
Port of Spain: Box 232. Tel. 6171. HARRIMAN. E. Herman Boos, dir.
INDUSTRIAL AGENCIES, LTD.
Dist., Oil Center Tool, (wellhead equipment & fittings); Equipment Engineers, Inc. (tension tubing anchors, tubing anchors, tubing catchers w/anchors, swabs, hydraulic line stippers, sucker rod strippers, polished rod blowout preventers & lubricators, stuffing boxes); Christensen Diamond Prod., (diamond coring, drilling equipment); Chiksan Export: (swing joints, steel rotary hoses, circulating heads, mud guns, reamers, disc bits, loading racks).
San Fernando: 14 High St. Tel. 3691. FERNTHOM. R. Fabey, mgr.
TRINIDAD OILFIELD SER.
Dist., Lane Wells, (technical oil field services, perforating well logging, packers); Baker Oil Tools (service cementing tools and specialized well completion equipment); Otis Engineering (specialized oilfield equipment).
San Fernando: Box 69. OILSERVICE. Tel. 3806. (Baker) Box 69. A. W. Tucker, mang. dir., H. C. Devenish, gen. mgr.
MODERN METHODS (CARIBBEAN)
Dist., Metallizing Eng., (metallizing equipment, wire).
Port of Spain: 233 Western Main Road. MODMETHOD. John S. Cox, mgr.
NEAL & MASSEY, LTD.
Dist., Tulsa Winch, (winches, power take-offs, speed reducers, transmissions); DuPont Co. (finishes); Cardwell (portable rigs, winches hoists, masts, drawworks); National Supply (oilfield supplies); Petrolite (Tretolite chemical demulsifiers, desalters, paraffin removers; Petreco electric desalting, dehydrating, distillate treating, etc.).
San Fernando: Box 20.
Port of Spain: Box 544.
ROOKS OILFIELD & ENG. SUP.
Dist., Foster Cathead, (power tongs, tong parts, catheads & parts, tension indicators); Oil Well Suply, (oilfield supplies); Lebus Inter'l. Eng. (grooving & controlled counterbalance wire line spooling systems).
San Fernando: 32 Shah St. Les Efforts. Tel. 4210. ROIL. John C. Rooks, mgr.
TAUREL & CO., LTD.
Dist., Cabot Shops, Franks Div., (pumping units).
Port of Spain: 30 Richmond St. Box 433. Tel. 6245. TAUREL. L. Taurel, mgr.
WILSON & JOHNSTONE, LTD.
Dist., Guiberson-Dresser Industries, (oilfield equipment, molded rubber products); Oakite (cleaning & descaling compound); Vapor Recovery System (equipment related to storage transportation of liquid).
Port of Spain: 3 Broadway. Box 431.
EDECO (TRINIDAD) LTD.
Dist., Security Inter'l. Dresser Industries (valves, alloys, rock bits).
San Fernando: Box 27.
HEYING, LORENCE J.
Dist., Magnet Cove Barium (drilling muds & chemicals).
San Fernando: 17 King St. Box 59. Tel. 3411. ALSTONS.
ALSTONS LTD.
Dist., Magnet Cove Barium (drilling muds & chemicals).
Port-of-Spain: 69 Marine Square. Box 600. ALSTONS. L. J. Burr, mgr.
HARDWARE & ELECT. SUP. LTD.
Dist., Union Carbide (welding & cutting equipment).
Port-of-Spain
THOMAS PEAKE & CO.
Dist., Union Carbide (metal-cutting tools).
Port-of-Spain

TRIESTE

C. ZETKO
Dist., Insley (trench hoes, excavators, cranes).
Trieste: Via Marconi 36.
BRUNO BATHILANO
Dist., Shand & Jurs-GP sub. (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, data-logging).
Trieste: Via Mazzini 4.

TUNISIA

UNION INDUSTRIELLE AFRICAINE
Dist., Continental-Emsco, (drilling and producing equipment).
Tunis: 13 Rue Ali Bach Hamba. UNAFRIC. R. Saumagne, mgr.
SOFOSI
Dist., George F. Failing, (drilling rigs).
Tunis: 35, Rue de Metz.

TURKEY

GEOPHYSICAL SERVICE INTER'L.
Seismic, gravity and magnetic surveys and seismic data processing services.
Ankara: Sumer Sokar Yenisehir, Apt. 8/12. Box 633. Tel. 2-6219. L. S. Ramsey, supvsr.
HAMAMCIOGLU MUESSESELERI TICARET, TAS
Dist., Lane Wells, (technical oil field services, perforating, well logging, packers).
Istanbul: Beyoglu, Box 2020, HAMAMCIOGLU.
POLAR MADEN VE SANAY
Dist., Continental-Emsco, (drilling and producing equipment).

Istanbul: Istiklal Caddesi Metropol Han Kat 4. Tel. 44 30 25. POLARAS.

INTE'L DRILLING & WATER
Dist., LeTourneau-Westinghouse, (construction machinery).
Ankara: Ataturk Bulvari 156. INTERDRIL.

KOC TICARET, TAS
Dist., Marmon-Herrington, (Fords).
Ankara: Box 72. Tel 10450-2. KOC.

DR. NADJI ADAY TICARETEVI
Dist., Tracerlab, Inc. (nuclear instrumentation, radiation detection equipment, radioactive chemicals consulting service, isotope applications).
Galata-Istanbul: Kemenkes St., Veli Alemdar Hankat 6, No. 20/30.

TOKAR LTD.
Dist. Carrier Corp. (air conditioning, refrigeration, heating).
Istanbul: Box 852. Galat a. Kaptanpasa Ciplagi 15. Sishane. TOKARAR. Tel. 445940.

VECDI DIKER
Dist., Oil Well Supply, (oilfield supplies).
Ankara: Mithat Pasa Caddesi 54-B.

RALPH M. PARSONS CO.
Engineering-construction.
Ankara: Midhat Pasa Caddesi 46/11. Box 1035. Yenisehir Branch. Tel. 2-5100. Zafir Tulga, mgr. PARSTURK.

INDUS. EQUIP. & SUPPLY
Dist., National Supply (oilfield supplies).
Ankara: 9 Istas Apartmani. 6/1 Gazi Mustafa Kemal Bulvari. Yenisehir. INDUSUP. Tel. 23740.

MEHMET KAVALA
Dist., Insley (trench hoes, excavators, cranes).
Istanbul: Galata, Tahir Han.

ETS. MEHMET VASFI
Dist., Insley (trench hoes, excavators, cranes).
Istanbul: Box 143.

YAKO S. TOLEDO VE ORTAGI STI
Dist., DuPont Co. (finishes).
Istanbul. B.P. 296.

MEHMED BAYAZID
Dist., DuPont (elastomers).
Istanbul: Yani Kapudag. B.P. 1067. Galata.

YAKIN DOGU MEKINE AS
Dist., Curtis-Wright (alloy steel pressure pipe).
Ankara: Akay Sokar No. 1/4. Vekaletler. Tel. 47585-86-87-88. Sungu R. Soyak, mgr. YAKIN.

UNITED KINGDOM

CANADIAN AERO SERVICE
Airborne geophysical surveys, aerial photography, photo and topo maps.
London: 20 Albert Embankment. Reliance 6828. AERCORP. Wm. P. DesLaurier, mgr.

AEREX LTD.
Dist., Hartzell Propeller Fan, (fans, blowers).
Sheffield: 220/238 West St. Tel. 28441. TELEX 54-206. A. E. Lawrie, mgr.

ARMSTRONG WHITWORTH & CO.
Dist., Thor Power Tool, (air tools, hoists, paving breakers, rock drills, grinders, drills, chipping hammers, pumps).
Tynemouth: North Shields 3111. ARMWHITOOL. R. G. Faverty, man. dir.

BIRWELCO LTD.
Dist., Petro-Chem Develop., (service for fluid refinery and chemical plant heaters).
Birmingham: Chester St., Aston. Tel. East 1171. BIRWELCO. R. G. Lewis, mgr.

CARRIER ENGINEERING CO.
Air conditioning, heating, refrigeration.
London: 24 Buckingham Gate. Tel. Victoria 6858. Telex. London 8579. DRYSYS.

BRITISH MANZEL OIL PUMP
Force feed mechanical lubricators and chemical feeders.
Carlisle: Durranhill Road. Tel. 21418 LUBRIFIERS. J. A. Howard, mgr.

BROWN & ROOT OVERSEAS
Engineering, design, project management, construction & maintenance ser.
London: St. Swithin's House, Walbrook. E. C. 4.

CAMERON IRON WORKS, LTD.
Blowout preventers, Xmas trees, valves & instruments.
London: 76 Grosvenor St. Tel. Hyde Park 9831. CAMIRON. Frank Pritchard, mgr.

CONTINENTAL-EMSCO CO.
Drilling and producing equipment.
London: 778/780 Salisbury House. Tel. National 3936. COMEMSCO J. M. Leitch, mgr.

DRAYTON REG. & INST. CO.
Dist., Armstrong Machine Works, (traps).
Middlesex: West Drayton.

EMCO BRASS MFG. CO.
Dist., Wheaton Brass Works, (valves and fittings).
Margate, Kent: Ramsgate Road. Tel. Thanet 21521. EMCO. W. F. Judd, mgr.

GEOPHYSICAL SERVICE INTERN'L.
Seismic, gravity & magnetic surveys, seismic data processing services.
London: Roman House, Cripplegate Buildings. Tel. Monarch 4511. W. D. Black, opera. mgr.

HOUDRY PROCESS
Houdry processes.
London: 21, Ironmonger Lane, Tel. Monarch 3884/5. Ralph Sassoon, mgr.

HUDSON ENGINEERING CORP.
Process plants.
London: 17 Stratton St. Picadilly.

ICI (HEAVY ORGANIC CHEM. LTD.)
Dist., Quaker Oats, (Furfural).
Billingham: Stockton-on-Tees 53601. J. D. Conduit, mgr.

JET-LUBE, INC.
Thread compounds for drill collars, tool joints, casing & tubing, oilfield grease specialties.
Wolverhampton: Park Lane, Fallings Park. JETLUBE. Malcom Curry, mgr.

JOSHUA HINDLE & SONS
Dist., Hamer Valves, (lubricated plug valves, slush pump valves seats, line blinds, pump line sleeves, flanges).
Leeds: Neville St. Tel. 30567. JOSHINDLE, W. Gomersall, mgr.

LEEDS FIRE CLAY CO.
Dist., Mexico Refractories, (refractory castables, mortars, ramming materials).
Leeds: Box 81 — Wortley. Tel. 63-8021/4. John Mutch, sepc. div.

LINCOLN ELECTRIC O.
Dist., Aircair Co., (removal torches, copperclad electrodes, welding supplies).
Herts: Broadwater Road. Tel. Welwyn Garden 920. SHIELD ARC. R. J. Wright, export sales mgr.

LUCEY EXPORT LTD.
Oil industry equipment & supplies.
London: 54 Old Broad St. Broad Street House. LUCEOIL. J. E. Marshall, mgr.

F. PERKINS LTD.
Dist., Solar Aircraft, (gas turbine engines).
Peterborough: Eastfield Factory. Tel. 4861. PERKOIL. M. L. Prichard, dir.

WOODFIELD ROCHESTER, LTD.
Dist., LeBus International Engineers, (grooving & controlled counterbalance wire line spooling systems); Ideco-Dresser Industries (drilling rigs, drilling & production equipment).
London: 147 Victoria St., Tel. Tate Gallery 4135. POWERRIGS. Gordon Fraser, mgr. G. Sturdwick, dir., Ideco.

MISSION MANFG. CO.
Oilfield equipment.
London: 17 Hanover Square. W. O. Calvert, mgr.

OIL WELL SUPPLY CO.
Oilfield supplies.
London: 5 Queen St.

PERKIN-ELMER LTD.
Infrared spectrophotometers.
Beaconsfield: Tel. 1570. PECO. Ralph Gilson, mang. dir.

REAVELL & CO. LTD.
Dist., GPE Controls-GP sub. (valves, controls processing equipment, data-logging, automatic computing & control equipment).
Ipswich: Box 44. Ranelagh Works. REAVELL.

REED ROLLER BIT CO.
Rock bits, tool joints, drill collars, coring equipment.
London: Moorgate Hall, 153 Moorgate. Tel. Monarch 6854. REEDBIT. T. C. Lemcke, mgr.

ROGERS GEOPHYSICAL CO.
Geophysical contractor, seismograph, magnetometer.
London: 1-3 Arlington, St. Jame's. ROGEXCO. Tel. Mayfair 8319. R. H. Talty, mgr.

SOLARTRON ELECTRONIC GROUP
Dist., Tracerlab, Inc., (nuclear instrumentation, radiation detection equipment, radioactive-chemicals, consulting service, isotope applications).
Thames Ditton, Surrey:

SPIRO-GILLS LTD.
Dist., Griscom-Russell Co., (fin fan heat exchangers).
Pulborough: Sussex. Tel. Pulborough 2401/5. SPIRO. Duncan Cook, mgr.

J. STONE & CO.
Dist., Carrier Corp., (air conditioning, heating, refrigeration).
London: Arklow Road. Tel. Tideway 1202. Telex. 8579. TOSTONES.

STONE & WEBSTER ENG. CORP.
Petrochemical & chemical plants, power station, industrial plants.
London: 20 Red Lion St. Tel. Chancery 3366. STOWEBENG. Karl Finsterbusch, mg. dir.

THOR POWER TOOL CO.
Electric & air tools, construction, vibrators, trowels, screens.
London: 34 Victoria St. Westminster. Tel. Whitehall 5944. THORTOOL. George Wall, dir.

WHESSOE LTD.
Dist., Shand & Jurs, (valves, controls, processing equipment, data-logging, automatic computing & control equipment); Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels).
Darlington: Tel. 5315. WHESSOE.

DEWRANCE & CO., LTD.
Dist., Yarnall-Waring Co.
Steam traps & strainers.
London

SUNVIC CONTROLS LTD.
Dist., Barton Inst. (twin bellow flow meters).
London: WC 2. 10 Essex St. Strand. Tel. Temple Bar 7064-8.
Harlow, Essex: Box 1, Adams House. Tel. Stone Cross 25271.

WORTHINGTON-SIMPSON LTD.
Air conditioning, heating, refrigeration, pumps, compressors, etc.
London

B. T. R. INDUSTRIES, LTD.
Dist., Resistoflex Corp. (Teflon hose,

fittings, hose assemblies, piping & components).

London: Hergn House Vincent Square. Tel. Victoria 3848. W. D. Scott, mgr. BRITGOODS.

OIL WELL ENGINEERING

Dist., Chiksan Export (swing joints, steel rotary hoses, circulating heads, mud guns, reamers, disc bits, etc.).

London: Cheadle Heath, Stockport. Tel. Gatley 2214. OLIFERS.

ARMOUR CHEMICAL INDUSTRIES

Dist., Armour Chemical Div. (production, refining chemicals, refined product additives).

London: EC1, 4 Chiswell St. Finsbury Square. Tel. Metropolitan 0031. ARMOCHEM SOUPHONE. M. K. Schwitzer, mgr.

NORTON GRINDING WHEEL

Dist., Norton Behr-Manning (porous mediums, catalyst carriers, bricks, cements).

Welwyn Garden City, Herts.

LUMUS CO., LTD.

Refinery construction.

London: 80 Reagent St. T. Shelley, mgr.

MOFFAT ENG. CO., LTD.

Dist., Curtis Wright (alloy steel pressure pipe).

London: W.1. 77 South Audley St. Tel. Hyde Park 6908. A. C. R. Moffat, mgr. MECHOIL.

JOY-SULLIVAN LTD.

Dist., Baash-Ross (oilwell drilling & producing equipment).

London: W.1. 7 Harley St. Tel. MA 3983. JOYLOADER. Gordon Rogers, mgr.

BIRCH & CO. LTD.

Dist., Aeroquip (hydraulic & aviation equipment).

London: EC 2. Moorgate Hall. 153 Moorgate.

SUPER OIL SEALS & GASKETS

Dist., Aeroquip (hydraulic & aviation equipment).

Kings Norton, Birmingham: Birmingham Factory Centre.

BLAKEBOROUGH, J., & SONS, LTD.

Dist., General Controls (automatic control valves).

Greetland, Nr. Halifax. Tel. Elland 3391/2. BLAKEBOROUGH. E. W. Singleton, mgr.

BORG-WARNER LTD.

Dist., Morse Chain (oilfield equipment & complete engineering services).

Letchworth, Herts: Tel. Letchworth 1833. CHAINDRIVE. C. W. Hankin, mgr.

BROWN FINTUBE (GB) LTD.

Heat exchangers.

Birmingham: 6. Chester St. Tel. East 1171. BIRWELCO. A. C. Brown, mgr.

CHICAGO BRIDGE LTD.

Dist., Chicago Bridge & Iron (oil storage tanks, evaporation saving equipment, refinery vessels, steel construction).

London: 36/37 Piccadilly. Tel. Gerrard 7425. CHIBRIDCO. C. A. Wooten, mgr.

DAWE INSTRUMENTS

Dist., Branson Inc. (ultrasonic gaging & cleaning equipment, flaw detectors).

London: 99 Uxbridge Rd. Ealing. DAWINST EALUX.

DETRICK, M.H., CO.

Engineered arches & walls for all types heat enclosures.

London: W.2. Bayswater. 60 Queen's Gardens. Tel. Paddington 1851. DETRICARCH. J. K. Mann, mgr.

ELLIOTT BROTHERS LTD.

Dist., Swartwout Co. (autronic control components & systems).

London: S.E. 13. Tel. Tideway 1271. Wm. Baker. OHMTELEX.

ENGLISH DRILLING EQUIP.

Dist., Security Inter'l.-Dresser Industries (valves, alloys, rockbits).

London: SW-1. Palace Chambers, Bridge St.

JOSEPH EVANS & SONS

Dist., Ideco-Dresser Industries (drilling rigs, drilling & production equipment).

Wolverhampton: Culwell Works. Tel. 20864-5-6. EVANS.

NATIONAL SUPPLY EXPORT

Oilfield supplies.

London: EC-1. City Wall House. 79-83 Chiswell St. Tel. Monarch 6398. ENESCODRIL. C. T. Reichert, mgr.

NEILL, WM., & SON LTD.

Dist., Vapor Recovery System (equipment related to storage & transportation of liquids).

Lancashire: Bold Irons Works. St. Helens Junction (main office). Tel. St. Helens 7363. NEILL, ST. HELENS. J. L. Laithwaite, dir.

London: SW-1, 38 Victoria St. Westminster. Tel. Abbey 5343. A. E. W. Baines, dir. (branch office).

PULSOMETER ENGINEERING CO.

Dist., Dresser Industries-Pacific Pumps (pumps); Ideco (drilling rigs, drilling & production equipment).

Reading: Nine Elms Iron Works. Eric Sanders, mang. dir., PULSOMETER.

PETROLITE LTD.

Tretolite (chemical demulsifiers, desalters, corrosion inhibitors, etc.; Petreco electric desalting, dehydrating, distillate treating, etc.).

London: Heathcoat House, 20, Savile. REGent 2566. KONTOL. Charles N. Stehr, mgr.

PROCON (GB) LTD.

Chemical, petrochemical, & petroleum plants.

London: WC-2. Bush House, Aldwych. Covent Garden 3131. J. R. Britt, mgr.

WESTINGHOUSE BRAKE & SIGNAL

Pneumatic controls for oil industry, hydraulic surge dampening.

Bristol: Hanham Road, Kingswood. J. D. Merrilees, div. mgr.

London: 82 York Way, King's Cross. R. Grant, mgr.

DURHAM RAW MATERIALS

Dist., DuPont Co. (petroleum chemicals).

London: EC-3. 1-4 Great Tower Street.

DU PONT CO. 'U.K.'

Elastomers.

London: SW-1. 76 Jermyn St.

MAGCOBAR DIV., DRESSER (GB)

Drilling mud & chemicals.

London: EC-7. 197 Knightsbridge. Tel. KNIghtsbridge 7681. MAGCOBAR. Peter W. Cooke, mgr.

BAILEY METERS & CONTROLS

Dist., Jerguson Gage & Valve (remote reading liquid level gages).

Croydon: Purley Way. Tel. Croydon 4191. BAILEMETA. W. G. Thomas, mgr.

JERGUSON TRESS GAGE & VALVE

Liquid level gages.

London: 30a Sackville St. REgent 8886. PHILJERG. Birks Creasser, mgr.

ENGLEHARD INDUSTRIES, LTD.

Petroleum catalysts.

Birmingham: 123 Vyse St.

CONSOLIDATED PNEUMATIC TOOL

Dist., Chicago Pneumatic Tool (air tools, air compressors, hydraulic equipment, percussion tools, etc.).

London: SW-6. 232 Dawes Road. CAULKING. (Order Prefix 42). Norman Readman, mgr.

HOLMES, W. C., & CO.

Dist., Roots-Connersville Blower-Dresser Industries (blowers, meters, vacuum pumps).

Huddersfield

SIE DIV. OF DRESSER

Dist., Southwestern Ind. Electronics (seismograph equipment).

London: SW-7. 197 Knightsbridge—8th floor.

URUGUAY

HORACIO TORRENDELL

Dist., Marmon-Herrington, (Fords).

Montevideo: Cuareim 2082. HORATORSA.

MONTEVIDEO AMERICAN IMPORT

Dist., Hercules Motors. (Hercules, Hall-Scott gasoline & diesel engines, Lycoming gasoline engines).

Montevideo: Paraguay 1962. Nilo G. Lombardero, mang. dir.

SUNEY SOCIEDAD ANONIMA

Dist., Modern Engineering, (oxy-acetylene welding & cutting apparatus & supplies).

Montevideo: Calle 25 de Mayo 73. 1-37.

GENERAL MACHINERY CO.

Dist., Cardwell (portable rigs, winches, hoists, masts, drawworks).

Montevideo: Ave. General Rondeau 1804. Tel. 8-67-07.

GREEN-CAMACO REFRACTARIOS SA

Dist., Oakite (cleaning & descaling compounds).

Montevideo: 12 De Diciembre 911. Olguiz Rodriguez, mgr.

KRUSCHNIROW, DLAUS

Dist., Aeroquip (hydraulic & aviation equipment).

Montevideo: Casilla Correo 1176.

KURT MAUTNER

Dist., DuPont Co. (elastomers).

Montevideo: Casilla De Correo 1431. Calle Colon 1392. Esc. 2.

CLERICETTI & BARRELLA

Dist., DuPont Co. (finishes).

Montevideo: Rincon 729.

MATEO BRUNET, SAC

Dist., DuPont Co. (photo products, polychemicals, petrochemicals).

Montevideo: Casilla De Correo 279. Paysandu 926.

SMITH, WILL L., SAU

Dist., Rockwell (meters, regulators, valves).

Montevideo: 1181-83 Avenida Uruguay.

JOSE MARIA DURAN, SA

Dist., Mack trucks.

Montevideo: Casilla de Correo 373. DURNA.

MAQUINAS & MATERIALES

Dist., Insley (trench hoes, excavators, cranes, etc.).

Montevideo: 18 de Julio 2302.

VENEZUELA

AERO SERVICE CORP. DE VENEZUELA

Airborne geophysical surveys, aerial photography, photo and topo maps.

Caracas: Apartado 6706. Thomas C. Oftelie, mgr.

AISLA, C. A.
Dist., Midwestern Pipe Line Prod., (pipe wrapping materials).
Caracas: Centro Commercial Del Este, Local 13. Calle El Colegio Sabana Grande. AISLA. E. J. Manzanares, mgr.

I. B. ALLEN
Dist., Rolo Mfg. Co. (metering units, BS&W water sampler); Rector Well Equipment (welding, cementing equipment, & Rectorseal).
Caracas: Apartado 9025. Tel. 3-2853. IBALLEN.

A-Z EXPORT, S. A.
Dist., Kimray, Inc. (regulators, control valves, temperature controllers, oil & gas equipment, controls); Brown Oil Tools, (well completion service, liner packers); Barton Inst. (twin bellow flow meter); Ideco-Dresser (drilling rigs, drilling & producing equipment); Morse Chain (oilfield supplies & engineering services); Chiksan Export (swing joints, steel rotary hose, circulating heads, loading rack, etc.); Lebus Inter'l. Eng. (grooving & controlled counterbalance wire line spooling systems).
Maracaibo: Apartado 304. AZESA. Guy LeBourgeois, mgr. Tel. 3480 & 6892. W. J. Berry, pres.
Puerto La Cruz: Apartado 4026. Tel. MG 086-332, & ANACO 86-259. AZEXPORT.
Las Maroches: (Barton).
Anaco: (Barton).

AXELSON, US INDUS.
Pumps, rod liners.
Maracaibo: Apartado 749.
Puerto La Cruz: Apartado 4131.

BEAIRD INTER'L. INC.
Pkg. compressor plants, pressure & contract vessels, dealer storage, LPG & AA systems, pkg. filling stations, transports, piling, rail car tanks, services-fabrication of steel products, hydrostatic testing, stress relieving, X-ray.
Caracas: Edificio Galipan. Apartado 6398. BEAIRD. E. S. McRoberts, v.p. Tel. 3-6511.

BS&B INTER'L. SA
Oilfield production and natural gas processing equipment; automatic controls.
Caracas: Ed. Torro del Este, 2 Piso. Avenida Fr. de Miranda. EXBLACK. Tel. 36-021. Allen Pike, Jr., mgr. Mailing address: Apartado 10718.
Maracaibo: Avenida Los Haticos, Callejon Santa Rosa, 116-142. Tel. 4128. James Clayton, mgr. Mailing address: Apartado 367.
Anaco: Camp Pretecca. Carretero Negro. Tel. MGO-86-263. EXBLACK. Eugene Seale, mgr. Mailing address: Apartado 4087. Puerto La Cruz.

BARITINA DE VENEZUELA
Dist., Baroid Div., National Lead, (drilling mud products and services, mud analysis well logging); Vapor Recovery System (equipment related to storage & transportation of liquids).
Caracas: Apartado 9117, Tel. 54-62-91. BARVENSA. Leonard Morgan, pres. & gen. mgr. G. W. Crocker, ass't.
Puerto La Cruz: Apartado 4097. R. E. Bates, Jr., east. div. mgr.
Maracaibo: Apartado 162. Rex W. Haile, West div. mgr.

BROWN & ROOT, INC.
Engineering, design, project management, construction & maintenance services.
Caracas: Quinta Lola, Campo Alegre. Apartado 3980. Tel. 31-51-11. J. BROWNBILT. J. Tro Sullivan, mgr.
Maracaibo: Ed. Gomez Castro. Avenida El Milagro. Apartado 314. Tel. 4851. 4852. 4853. BROWNBILT. J. F. Elliott.

CARBOLINE CO.
Protective coatings.
Caracas: Quinto Nino, Bello Monte. James C. Carriles, rep.

CAMERON IRON WORKS, INC.
Blowout preventers, Xmas trees, valves & instruments.
Barcelona: Box 19, c/o Phillips Pet. Co. Tel. 86-677. FILVIN. R. L. Barber, rep.
Maracaibo: Apt. 728. c/o C. A. Maquinairias. Tel. 79066. CAMIRON. R. L. Eakin, rep.

COMPANIA ANONIMA TECNOMAT
Dist., Hercules Motors. (Hercules & Hall-Scott gasoline and diesel engines, Lycoming gasoline engines); Modern Engineering (oxy-acetylene welding & cutting apparatus, supplies).
Caracas: Este 2. No. 191-4 Puente Republica. Apartado 108. Edwin A. Corrie, mgr. TEMA.

COMMERCIAL ALLEN, C. A.
Dist., Infilco Inc., (industrial filters).
Caracas: Ed. Pas de Callias, Veroes a Jesuitas 26, ler Piso, Of. D. Apartado 2212. Tel. 81-63-92. ALLEN. James C. Allen, Dr. Jose R. Hurtado, Ted Girolamo, mgrs.

INSTITUTE VENEZOLANO DE PETROQUIMICA
Dist., Cooper-Alloy Corp.
Caracas: Edificio Domas-Calle Chile. Avda, Victoria.

CONTINENTAL-EMSCO CO.
Drilling and producing equipment. Fibercast Co., (fibercast pipe, tubing, fittings).
Anaco: (Store) Box 4204. Puerto La Cruz. Edo. Anzoategui. VENMEX. Start message, CONEMSCO. J. R. Stebbins, mgr.
Caracas: Ed. Torre Del Este, 2° Piso. Avenida Francisco De Miranda. Apartado Del Este 5122. Tel. 33-47-24. CONEMSCO. W. G. Sharp, mgr.
Las Morochas: (Store) Distrito Bolivar Edo. Zulia. CONEMSCO. E. S. Warner, mgr.
Maracaibo: (Store) Kilometro 3, Carretera Perija, Maracaibo Edo. Zulia, Apartado 90. CONEMSCO. J. R. Aston, mgr.

COSASCO DIV. PERFECT CIRCLE
Piston rings.
Maracaibo: Hotel Del Lago Ofic. No. 14. Tel. 77718. PROMARA. Vincent J. Reh, pres., William B. Barbee, sales mgr.

DOWELL DIV. (Dow Chemical Int'l.)
Acidizing, fracturing, cementing, chemical cleaning service for industrial equipment.
Caracas: Ed. Galipan. Apartado 4309 del Este. Tel. 31877. Joe L. Thompson, res. mgr.
Anaco Station: Apartado 35, Barcelona. Tel. 86-323. J. P. Murphy, service mgr.
Barcelona: Apartado 35. Tel. 86-323. J. P. Murphy, serv. mgr.
El Tigre Station: Apartado 436 El Tigre. Tel. 83-501. J. N. Newberry, serv. mgr.
Maracaibo: Apartado 749. Tel. 71-071. W. P. Fitzgerald, sales eng.
Las Morochas Station: Apartado 76. Lagunillas, Estado Zulia. Tel. (Shell) 996-395, Creole (3225).

FRANKLIN SUPPLY-PETICON DIV.
Oil well supplies, tubular goods.
Maracaibo: No. 122-56 Avenida Los Haticos. Apartado 532. Tel. 4-586, 6-012.
Caracas: Apartado 9066 Candelaria. Tel. 54. 64. 46.
Anaco: Carretera Negra (100 KM Post).
Barinas: Avenida 23 De Inero 114.

CUMMINS SALES & SER.
Diesel engines.
Caracas: Ed. Polar, Seccion "B", En Plaza. Apartado del Este 4414. Tel. 42-6267 (shop 55-0594 office). R. E. Swann, rep. W. R. Bowman, gen. mgr.
Anaco: c/o S. A. Ven Mex, Puerta La Cruz. Apartado 4087. MIDCUMPORT. P. M. Bencze, rep., W. R. Bowman, gen. mgr.
Maracaibo: Apartado 90. Shop-Kilometro 4. Tel. 6506, Ext. 1. MIDCUMPORT. H. J. Derden, rep. W. R. Bowman, gen. mgr.

EAST-WEST OIL TOOLS, C. A.
Dist., Oil Center Tool, (wellhead equipment and fittings); Foster Cathead, (power tongs and tong parts); Hycalog, Inc. (diamond drill bits, diamond core bits, mud-logging equipment); Milwhite Mud Sales (drilling mud & engineer service).
Maracaibo: Del Lago Hotel. Apartado 273. Tel. 6711. Jim Harder, Chas. Smith, mgrs. Apartado 90, Milwhite.
Puerto La Cruz: Apartado 4158. Tel. 86-374. (Oil Center Tool, Foster Cathead).

EASTMAN INTERNATIONAL
Directional drilling, oil well surveys, star recorders.
Maracaibo: Avenida 5 de Julio 12-12. Apartado 699. Tel. 71451 and 71452. EASTCO. Louis S. Farnsworth, Jr.

GEOFISICA ROGERS
Seismograph contractor.
Caracas: Atlantic Bldg. Apartado 4641. Tel. 333140-333149. ROGEXCO. Lewis F. Judson, D. T. Nash, mgr.

GEOPHYSICAL SERVICES INTER'L.
Seismic, gravity and magnetic surveys — seismic data processing services.
Caracas: Ed. Desire, Calle Madrid, Urb Las Mercedes. Apartado 4413. del Este. Tel. 34-743. Ext. 1. J. Frank Fuller, supvsr.

GRAVER INTERNATIONAL SA
Graver Tank & Mfg. Co. (steel storage tanks, floating roof tanks, heaters, separators, bolted tanks, water treatment installations).
Caracas: 310 Ed. Central, Ibarras A. Pelota. Apartado 2658. Tel. 815286-7. GRAVERTANK. William I. Woodson, mgr.

GUIBERSON CORPORATION
Guiberson Corp.-Dresser Industries, (oilfield equipment & molded rubber products).
Puerto La Cruz: Ven-Mex, Apartado 4087. Tel. Anaco 86-253. George Haley, rep.
Maracaibo: 34-36 Calle 67 (Cecilio Acosta) Villa Tranquila. Tel. 79606.

J. H. WILLIAMS & CO.
Wrenches, sockets, chain pipe tongs, vises.
Caracas: Guanabano & Amadores. Box 555. Tel. 813616-415760. HEDDERICH. William Hedderich, rep.

HOMCO INTERNATIONAL
Oilwell fishing tools, directional drilling, oil field supplies.
Maracaibo: Apartado 686. Tel. 7-9525. HOMCO. George E. Matter, mgr.

JOAQUIN AVELLAN, SUCRS, C.A.
Dist., Armstrong Machine Works, (traps).
Caracas: Ed. Aragua-Puente Soublette.

LUFKIN FOUNDRY & MACH.
Pumping units and gas engines.

Anaco: c/o Remolques Venezolanos, C. A. Apartado 4168. Jack Jumper, mgr.
Maracaibo: Av. 17 Los Haticos. No. 128-60. Apartado 93. Roy Lilley, mgr.

MANUFACTURER'S DISTRIBUTORS
Safety switch-gages and automation devices.
Caracas: Ed. Galipan. MANDICA. Ike Ridenhour, mgr.

MEXICO REFRACTORIES
Refractory castables, mortars, ramming materials, firebrick.
Caracas: Apartado de Correos 4033. Tel. 61-74-22. DIEKMAN. Oluf Diekmann, rep.

MULTI-COLOR PROCESS
Decals, rubbercal emblems, etched & printed metal nameplate.
Puerto La Cruz: Carretera Negra. Tel. 1182. Arnold Briganti, mgr.
Maracaibo: Av. 17 (Los Haticos) 110-154. Tel. 4131. Arnold Briganti, mgr.

NALCO DE VENEZUELA, C.A.
Dist., National Aluminate Corp., (chemicals for industrial waters & petroleum-herbicides, corrosion inhibitors, coagulants).
Caracas: Ed. "Pas de Calais." Veroes A. Jesuitas 26-ler. Apartado 2212. Tel. 81-6392, J. C. Allen, mgr.

OFICINA TECHNICA STUBBINS
John Bean Div., Food Machinery & Chem., (core drilling pumps, high pressure piston pumps, stationary and portable firefighting equipment.) Northwest Eng. Co.; (shovels, cranes, draglines, and pull-shovels); Cardwell (portable rigs, winches, hoists, masts, drawworks); Johns-Manville Inter'l. (insulation materials); Dresser Mfg. (pipe couplings, fittings, sleeves, etc.); DuPont (explosives); Aeroquip (hydraulic & aviation equipment); Dewrance & Co. (steam traps, strainers).
Caracas: Apt. 7. Tel. 429-11 to 116. VENSTUBBIN. Gabor P. Morvay, mgr. (Johns-Manville).
Caracas: Apt. 3974. (Dresser).
Maracaibo: Apt. 162. Tel. 3440-6776/7/8. (Cardwell & DuPont).
Puerto La Cruz: Apt. 4072. Tel. 1146. (Cardwell & DuPont).
Caracas: Apartado 3958. EQSTUBBIN. Tel. 429. 125 AL 128. Jan M. Stein, mgr. (John Bean Div).
Caracas: Dolores a Puente Soublette. Apartado 3930. MAQSTUBBIN. Frank Belousek, mgr. (Northwest Eng.)

OIL BASE DE VENEZUELA
Oil base drilling mud.
Puerto La Cruz: Apartado 4168. Tel. 1325. OBVENCA. R. R. White, mgr.

OIL FIELD SALES & SER.
Dist., Garrett Oil Tools, (gas lift, equipment, motor valves & controllers, lease automation equipment, safety valves); Christensen Diamond (diamond coring & drilling equipment); Waukesha Motor (gasoline engines); Inter'l. Div.-U. S. Industry (pump shops, warehouse).
Puerto La Cruz: Apartado 4131. Tel. 86-307. OILFIELD-VENMEX. Paul Koestler, mgr.
Maracaibo: Apartado 749. Tel. 5068. KEARBY. Jerome Kearby, mgr. Tel. 70901-2. W. Richards, mgr. (USI)

PETRO-TECH SERVICE C. A.
Dist., Lane Wells, (technical oilfield services, perforating, well logging, packers).
Caracas: Apartado 2728. PETRO-TECH.

PRECISION TECHNOLOGICA, C. A.
Dist., Equipment Engineers, Inc., (tension tubing & tubing anchors, tubing catchers W/anchor, swabs, hydraulic line strippers & sucker rod strippers, polished rod blowout preventers & lubricators, stuffing boxes); Martin-Decker (indicating & recording drilling control instruments).
Caracas: Apt. Del Este 10718, Edif. El Torre Del Este, 2° Piso CHACAO. Tel. 36021. (Martin-Decker).
Anaco: Apt. Pto. La Cruz 4087. Camp Pretecca, Carretera Negra. Tel. MGO 86-263. (Martin-Decker).
Maracaibo: Apartado 367. PRETECCA. Paul Kentzel, mgr. Tel. 4128. Bernard Wuthrich, mgr. (Martin-Decker).

PRODUCTORA MARA, C. A.
Dist., Manzel, Unit of Houdaille, (force feed mechanical lubricators, chemical feeders).
Maracaibo: Hotel Del Lago, Oficina 14. Tel. 77718. PROMARA. William B. Barbee, mgr.

REED ROLLER BIT
Rock bits, tool joints, drill collars, coring equipment).
Barcelona: Apartado 36. REEDBIT. J. E. Orton, mgr.

PEYTON GRADY RODGERS
Dist., Associated Eng. & Equip.
Acoustical well sounder and supplies (fluid level instrument).
Maracaibo: Apartado 749.

STANDARD DIR. DRILLING
Dist., Drltrol, (drill collar, drillable wing stabilizers).
Maracaibo: Avenida 2A. 84-176. Quinta Joaicony. Tel. 7-9231. Blackie Armell, mgr.

SANCHEZ & CIA, S. A.
Dist., Marlow Pumps — Bell & Gossett (pumping equpiment); Union Carbide (welding & cutting equipment).
Caracas: Santa Teresa a Cipreses 67. Apartado 1006. Tel. 419111 thru 19 (10 lines). SANCHEZ. Dr. Felix Metzner, mgr.

SERVICIOS ANTI-CORROSIVOS, SA
Dist., Amercoat Corp. (protective coatings, vinyls, epoxies, dimetcote).
Caracas: Ed. Cruz de Condelaria. Apartado 2031.
Maracaibo: Calle 67, 25-40. Quinta Nina.

SERVICIOS INDUSTRIALES, C. A.
Dist., Grant Oil Tool, (drilling tools and production equipment); Cabot Shops & Franks Div. (pumping units; drilling well servicing, workover equipment).
Maracaibo: Avenida 17 No. 123 101. Apartado 594. Tel. 2838. R. I. Jarvis, mgr.
Anaco: Apartado 30. Tel. 86-239. SICA. Gordon Mashmeyer, mgr.
Las Morochas:
Barinas: c/o Eastman Oil Well Survey Co. SICA c/o Eastman.

SERVICIOS TECNICOS ATLAS S.A.
Dist., Perforating Guns Atlas, (wire line services, logging, perforating, etc.).
Maracaibo: Hotel del Lago, Apartado 90. Tel. 77710 STACA. George M. Yoder, mgr.

SINCLAIR SPENCE, C. A.
Dist., Shand & Jurs-GP sub. (safety equipment for storage tanks, automatic level gages & indicators, remote control equipment, & data-logging); Daniel Orifice Fitting (orifice fittings, pressure bombs, gas heaters, manometers, etc.); GPE Controls (valves, controls, processing equipment data-logging, automatic computing, control equipment).
Caracas: Edificio Galipan No. 22. Tel. 32.858. Sinclair Spence, mgr.

SPENCER-SAFFORD LOADCRAFT
Oilfield material, trucks & floats.
Caracas: Apartado 3985. Tel. 55.70.53. CAMEQUIP. Oscar Padilla, mgr.

C. J. STREETLY
Dist., Rolo Manufacturing, (well checker, meter unit, BS&W water sampler).
Barcelona: c/o Phillips Petroleum Co. San Roque Camp. Apartado 19. STREETLY FILVEN.

TOWER CONSTRUCTION CO.
Radio, Vhf, microwave towers, microwave buildings, microwave passive reflectors.
Caracas: Quita El Milagro. Avenida El Mango. Urbanization San Antonio. Tel. 52.766. TOWERS. Poul Bretow, mgr.

UNITED STATES STEEL INTERN'L.
Dist., Oil Well Supply, (oilfield supplies).
Caracas: Ed. Galipan, Oficina C-2-D. Avendia Francisco de Miranda. Tel. 31-409.
Maracibo: Apt. 81.
Anaco: Address mail to Caracas.

VENEZUELAN SUPPLY C.A.
Multi-Color Process Co., (decals, rubbercal emblems, etched and printed metal nameplates); George F. Failing, (drilling rigs).
Caracas: Apartado 1871. Tel. 71-53-21. VENSU. Arnold Briganti, mgr.

WALCO, S.A.
Dist., Tulsa Winch, (winches, power take-offs, speed reducers, transmissions); Hilliard Corp., (filtering items); DuPont Co. (elastomers).
Puerto Ordaz
Puerto La Cruz: Apartado 4152.
Caracas: Calle el Progreso. Ave. Victoria. William A. Waldrip, mgr. Box 4347.
Maracaibo: Ave. Bella Vista 64-89.

WELEX INC. OF VENEZUELA
Perforating, logging, wire line service.
Maracaibo: Apartado 470. R. H. Winn, mgr.

WILSON MANUFACTURING CO.
Rigs, winches, pumps, masts.
Maracaibo: 3G-36 Calle 67, Villa Tranquila. Tl. 75365. JWDAHLINE. J. W. Dahline, mgr. Apartado, 749.
Puerto La Cruz: c/o S.A. Ven-Mex. Apartado 4087. George Haley, rep. HALEY VENMEX.

WOLBECO, C.A.
Dist., Metallizing Eng. Co., (metallizing equipment, accessories & wires).
Caracas: Avenida les Pises el-Paraiso. Apartado 6007. Ed. Blancar 18. WOLBECO. W. Beichbuchner, mgr.

YETCO, C.A.
Dist., Oil Metering & Processing, (crude oil metering and testing equipment); Web Wilson (drilling tools); American Iron & Machine (packers & overshots); I. H. Grancell (lead seal compound).
Maracaibo: Avenida 23. No. 72.56. Apartado 680. Tel. 77460-M. YETCO. Norman E. Yett, mgr.
Puerto La Cruz: Apartado 4072. Paul Huffacker, mgr. (AI&M).

S.A.V.E.R. GUINAND
Dist., Carrier Corp., (air conditioning, heating, refrigeration).
Caracas: Ave. 400-Urbanizacion Puente Soublette. Apartado 668. SAGUINAND. Tel. 42-011, 42-912, 420913.

TECMAR—RESLER Y CIA
Dist., Carrier Corp., (air conditioning, heating, refrigeration).
Maracaibo: Callejon del Asilo No. 85-39. (Avenida Falcon). TECMAR. Tel. 4618.

SERVICIO TECNICO DE POZOS OTIS.
Dist., Otis Engineering (specialized oilfield equipment).
Maracaibo: Apartado 776. Tel. 77711. OTIS. V. R. Cherry, mgr.
Puerto La Cruz: Apartado 4191. Tel. 86-378.

GENERAL GEOPHYSICAL CO. DE VENEZUELA
Geophysical contracting.
Caracas: Apartado 1871. Tel. 715321. GENERALGEO. C. William Penny, mgr.

ALAMBRES Y CABLES VENEZOLANOS
Dist., Phelps Dodge Copper (copper wire & cable, pipe & tube).
Caracas: Edif. Las Marias. Ave. Urdaneta, entre Norte 9 y 11. Air mail 1587. Tel. 55-20-56. Russell C. Bowen, mgr. ALCAVE.

CORE LABORATORIES
Mud logging, core analysis, reservoir fluid analysis, special core analysis, petroleum reservoir engineering.
Maracaibo: Apartado 116. Tel. 73287 & 73288. CORELAB. J. W. Barbour, Jr., mgr.

EQUIPEX, S.A.
Dist., Foxboro Co. (industrial instruments).
Caracas: Edif. Galipan B2B. Apartado 4607, Este. Tel. 3-2662. EQUIPEX. R. Lopez, mgr.

CARDWELL MFG. CO.
Portable rigs, winches, hoists, masts, drawworks.
Caracas: Apartado 7. Tel. 429-111 & 116. VENSTUBBIN. Jules Haltenberger.

MAGCOBAR DE VENEZUELA
Dist., Magnet Cove Barium-Dresser Industry (drilling mud & chemicals).
Puerto La Cruz: Calle Venezuela No. 112, Pueblo Nuevo. Tel. 2241 & Meneg 81231. MAGCOBAR. K. L. Byerly, Jr.
Caracas: Edif. Luz Electrica. Ave. Urdaneta. Box 3775. Tel. 543541 AL 48.
Maracaibo: Edif. UPEMA 6th Floor, Calle 76 Cruce Con Ave. 12. Tel. 73471-72.

SCHNECK, ROGER C.
Dist., W. H. Curtin (lab apparatus, petroleum testing equipment, reagent chemicals).
Caracas: Apartado 10226.

GEUSS, GEORGE
Dist., Edward Valves (steel, cast, forged valves); Rockwell (meters, regulators, valves).
Caracas: Edif. Gran Ave. Plaza. Box 566. Tel. 54-33-96 & 71-66-85. REICCO GEUSS. George L. Geuss, mgr.

OFICINA TECNICA JAIMES
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Caracas: Apartado 2254.

ACO, S.A.
Dist., Insley (trench hoes, excavators, cranes, bucket carts).
Caracas: Apartado de Correo 3948.

BAKER TRANSWORLD, INC.
Cementing service tools, shoes, collars, centralizers, scratchers & well completion equipment.
Maracaibo: Calle 58-B, Quinta 4A-39 "Por Fin". Tel. 6323 (residence). Tel. 7-6933. BACASO. John Reeves, Jr.
Punta Gorda, Zulia: c/o Creole Petroleum. Tia Juana, Estado Zulia, Venez. Tel. 3774. BACASO. C. T. Abbott.
Lagunillas, Zulia: c/o Creole Petroleum, Tia Juana, Estado Zulia, Venez. Tel. 680. E. N. Davies, mgr.
Anaco, Anz.: Box 2658, Caracas, D.F. Tel. 86-243 & 250. W. C. Wilson, mgr. WARHALL.
Jusepin, Monagas: Box 2658, Caracas D.F. Tel. 87-389. M. D. Davidson, mgr. WARHALL.
Roblecito, Guarico: Box 2658, Caracas. WARHALL.

CHICAGO BRIDGE & IRON
Oil storage tanks, evaporation saving equipment, refinery vessels.
Caracas: Apartado 1348. Tel. 71-63-61-62. CHIBRIDGE. Richard A. Williams, mgr.

INTERTEC, C.A.
Dist., Hills-McCanna (diaphragm valves, chemical, metering, & proportioning pumps); Selas (tubular furnaces for continuous processing, burners, dehydrators).
Caracas: Edif. Galeria Bolivar No. 25. Ave. Principal Salano Grande. Apartado 5463. ESTE. INTERTEC. H. D. Frenkel, tech. dir. Tel. 71-89-13.

NATIONAL SUPPLY OF VENEZ.
Oilfield supplies.
Caracas: Edif. Galipan. Planta Baja-Oeste, Urb. El Rosal. L. L. Leigh, mgr. ENESCODRIL. Tel. 32-904, 32808. (Headquarters—office only).
Maracaibo: Hotel Del Lago. Apartado 90. Tel. 77719. (Office & warehouse).
Las Morochas: (mailing address—c/o Maracaibo) (warehouse).
Puerta La Cruz: Apartado 4021. (warehouse).
Barinas: (mail address—c/o Caracas). (warehouse).

AMERICAN CONSTRUCTION CO.
Dist., T. D. Williamson, (tapping machines, stopples, pigs, casing seals, insulators).
Cabimas, Zulia: Ralph H. Colton, mgr.

PETROMAC
Dist., Oakite (cleaning & descaling compound).
Maracaibo: Calle 76 Ave. 3-C. No. 76-07 Quinta Rosay. R. O'Day, mgr.

ED CARNE
Dist., Baash Ross (drilling & producing equipment).
Caracas: Apartado 3992. HYDROCARB.

GAS LIFT, C.A.
Dist., Merla Tool (gas lift equipment).
Anaco: J. D. (Pat) Du Priest, mgr.

BUCKNER, J. FRED
Dist., Bryon Jackson (drilling & producing equipment).
Maracaibo: c/o Urbanizacion Sucre. Frente a la Plaza No. 26-17. Apartado 749. Tel. 7-0901-02.

MID-CONTINENT SUPPLY CO.
Dist., W. C. Norris (sucker rods).
Caracas: Apt. del Este 4414. En Plaza Venezuela. Tel. 55-0594.
Maracaibo: Apartado 605. Tel. 7-7713. MIDCUMPORT.

PETROLEUM INDUSTRY CONSULTANTS
Dist., Armite Laboratories (anti-seize sealing compounds, drilling collar & tool joint compounds; Shaffer Tool (blowout preventers, flow beans, casing heads, control gates, etc.).
Caracas: Apartado 3992. PETICON. G. M. Davies, mgr.

GENERAL MOTORS DE VENEZ.
Diesel engines, vehicles, spare parts, service.
Caracas: Carapa, Carretera de Antimano. Tel. 24-134 219 135 733 or 23-438/474. CARCAUTOEX.

SUMNER, ORBIE L.
Dist., Orbit Valves.
Maracaibo: Ave. El Milagro 93-42.

SOUTH AMERICAN PETROLITE
Tretolite chemical demulsifiers, desalters, corrosion inhibitors, etc.; Petreco electric desalting, dehydrating, distillate treating, etc.).
Caracas: Hotel Avila. Tel. 55-61-11. Mont Land, mgr.

SERVICIOS HYDROCARB C.A.
Dist., B & W Inc. (scratchers, centralizers, friction lock clamps).
Los Morochas: (field stocks).
El Tigre

SERVCO DE VENEZUELA, C.A.
K-monel drill collars, milling tools, engineering services.
Maracaibo: Apartado 116. SERVCO. Bruce J. Cordary, mgr.

SCHLUMBERGER-SURENCO SA
Electrical logging, gun perforating.
Caracas: Apt. 1608. SURENCO. R. D. Ford, pres. M. Demoustier, vp-operations.

SECURITY INTERN'L., C.A.
Dist., Security-Dresser Industries (valves, alloys, rock bits).
Caracas: Apartado 4880. Correos Del Este. ENGOSEG.

VICAPROCON S.A.
Dist., Procon Inc. (erection of petroleum refinery, chemical, and petrochemical plants).
Caracas: Residencia La Hacienda, Apt. 31-F. Tel. 37-34-14. Lewis Leader, vice president.

FCO. SAPENE E HIJO
Dist., Union Carbide (welding & cutting equipment).
Caracas

COMPANIA ANONIMA VENEZOLANA AGA
Dist., Union Carbide (welding & cutting equipment).
Caracas

GENERAL ELECTRIC DE VENEZ.
Dist., Bucyrus-Erie (drills & construction machinery).
Caracas
Barranca
Maracaibo
Puerto La Cruz

YUGOSLAVIA

KONTINENTAL
Dist., Oil Well Supply, (oilfield supplies).
Belgrade: Terazije 27/III.

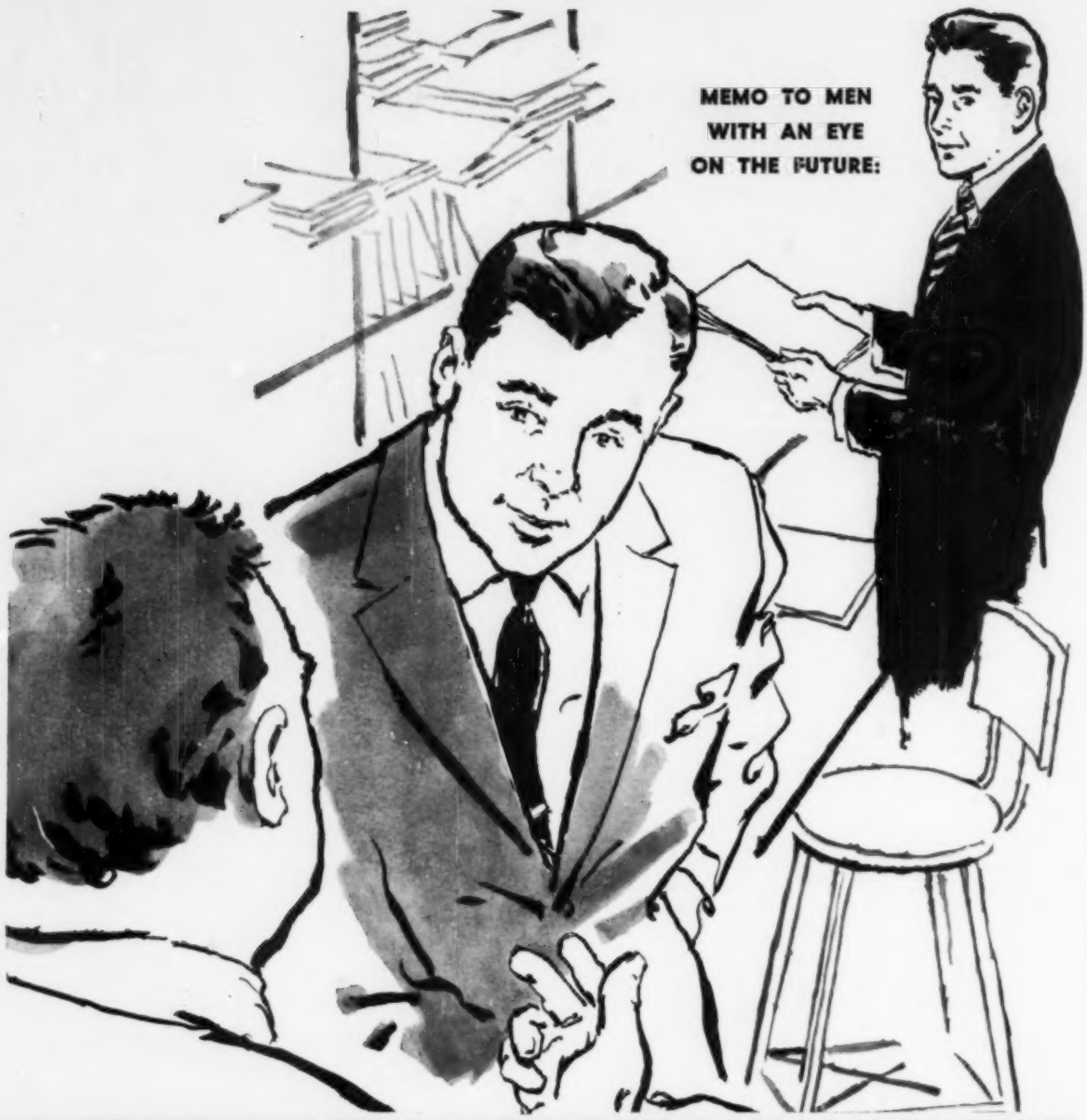
MERKANTILE
Dist., Lane Wells, (technical oilfield services peforating, well logging, packers); Eastman Oil Well Survey, (directional drilling surveying, star recorders); Cardwell (portable rigs, winches, hoists, masts, drawworks). Security Inter'l.-Dresser Industries (valves, alloys, rock bits). Baker Oil Tools (technical advice); Dresser Mfg. (couplings, pipe clamps, sleeves, etc.).
Zagreb: Box 23. Praska Ul. 2. MERKANTILE. Rifat Pasic, Drazo C. Herzog, mgrs. (Baker).

HEMOTEHNA
Dist., DuPont Co. (photo products).
Belgrade: Box 852.

UNIVERZAL
Dist., DuPont Co. (finishes, elastomers).
Belgrade: Knez Mihajlova 25.

MASINOKOMERC
Dist., Ideco-Dresser Industries (drilling rigs, drilling & production equipment).
Belgrade: Kneza Mihail 1. Tel. 22-341. MASINOKOMERC.

INTERCOMMERCE
Dist., Bucyrus-Erie (drills, construction machinery).
Belgrade



WHERE THERE'S ENGINEERING ACTION THERE'S THE "ENGINEER"

As anyone knows who's ever tried to fix a faucet, hang a door, or change a tire – you're much better off with the proper tools at hand.

Every astute engineering/operating man knows this. He wouldn't consider for a minute attempting to do his job without having all his tools at his disposal. And his tools are comprised of information. Complete information. Sound information. Timely information.

He makes it his business to absorb all that information – from the edition of the "Engineer" that he subscribes to in his particular field. He reads it for profit, not for pleasure. He reads it carefully, searchingly . . . looking for facts, for new ideas and methods, for new products he can put to work. And – because he finds so much that's useful in the advertising pages – he reads them with the same concentration he devotes to the editorial pages.

Take a tip from the key men at every engineering/operating level. Subscribe to your edition of the "Engineer." Read every issue. Carefully. Thoroughly. Searchingly.

THE PETROLEUM ENGINEER for Management

THE PETROLEUM ENGINEER, Drilling & Producing

REFINING ENGINEER

PIPELINE ENGINEER

PETROLEUM ENGINEER PUBLISHING COMPANY, Box 1589, Dallas 21, Texas

Acidizing? Fracturing? Waterflooding?

GET HIGHER INJECTION RATES with LOWER PUMP PRESSURES

Case History No. 1

Area – West Texas
Formation – Ellenberger Dolomite
Depth – Below 12,000'

BEFORE VIBRO-FRAC, acidizing injection rate averaged .15 bbls. per minute at 6500 p.s.i.

VIBRO-FRAC treatment started with perforating six feet of the casing with E-Gun and three VIBRO-PERFORATOR shots. This was followed by two open hole type VIBRO-FRAC charges in a 19' section of open hole and two casing type VIBRO-FRAC charges in the six foot section of cased hole.

After VIBRO-FRAC, acidizing injection rate started at 1.9 bbls. per minute at 5800 p.s.i. The injection rate increased to 7.3 bbls. per minute and the pressure dropped to 2600 p.s.i.

Case History No. 2

Area – West Texas
Formation – Devonian Chert
Depth – Below 8,500'

BEFORE VIBRO-FRAC, this formation would not take acid in offset wells.

The twelve foot zone of interest was perforated with 72 E-Gun holes and three VIBRO-PERFORATOR shots. Three casing type VIBRO-FRAC charges were spaced in the twelve foot zone.

AFTER VIBRO-FRAC, formation took acid at the rate of 2.4 bbls. per minute at 1500 p.s.i.

Acidizing a formation can mean the difference between a commercial producer and a dry hole. But how do you acidize a formation that won't take acid?

Many formations require extremely high pump pressures. Some formations won't break down at all. For these wells pre-treatment with VIBRO-FRAC, Lane-Wells explosive well stimulation service, makes acidizing practical. Selective fracturing produced by VIBRO-FRAC treatment opens up the formation — lets the acid in to do its work.

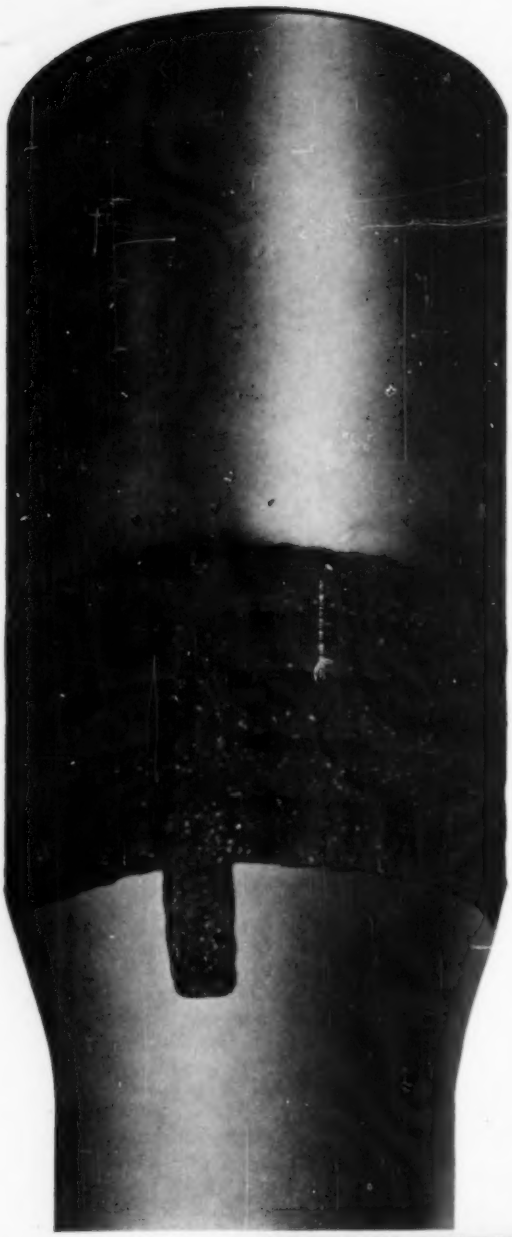
Improved VIBRO-FRAC charges can be run without depth or pressure limitations. Ask your Lane-Wells man how VIBRO-FRAC can help you with acidizing—or any type of fluid injection problem formations.

LANE-WELLS COMPANY

A Division of Dresser Industries, Inc.

P. O. BOX 1407 HOUSTON 1, TEXAS

VIBRO-FRAC and VIBRO-PERFORATOR Reg. U. S. Pat. Off. by Petroleum Tool Research, Inc.



Hughes FLASH-WELD is now 21

At 21, Hughes "Flash-Weld" is the most experienced welded tool joint-to-pipe connection in the oil fields.

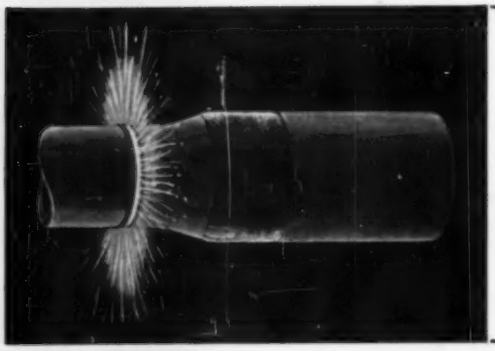
Since 1938, when Hughes introduced the first flash-welded drill string, *more than 40 million feet* of drill pipe have been unitized by the "Flash-Weld" process.

A new heat treating process has *more than doubled* the tension impact strength of "Flash-Weld" pipe connections. And new processing controls are improving the quality of the finished drill strings.

In addition to exacting physical tests, "Flash-Weld" tool joints and flash-welded connections undergo a series of critical inspections. For instance, after flash-welding, all weld areas are subjected to magnetic particle inspection. The critically-stressed areas of the tool joints themselves (this applies to all Hughes joints) are magnetically inspected. And the hardfacing on the joints is "snow" tested to check the bond of the hardfacing material to the joints.

The Hughes method of hardfacing, plus Hughes' specially developed tungsten carbide hardfacing material, assures maximum protection against wear during the life of the joints.

FLASH-WELD
A DEVELOPMENT
OF
HUGHES
TOOL COMPANY
HOUSTON, TEXAS



Complete line of "Flash-Weld" joints is available for attachment to new API LIGHTWEIGHT drill pipe, as well as standard weight pipe. Ask your Hughes man.

"Flash-Weld" joints are available with tapered and square shoulders